LOGAN, T.M.:

Report on the medical topography...1865.

REPORT

ON THE

MEDICAL TOPOGRAPHY AND EPIDEMICS

OF

CALIFORNIA.

BY

THOMAS M. LOGAN, M. D.,

OF SACRAMENTO, CALIFORNIA.

EXTRACTED FROM THE

TRANSACTIONS OF THE AMERICAN MEDICAL ASSOCIATION.

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PRELIMINARY.

The Reporter of the American Medical Association on the Medical Topography and Epidemics of California, while expressing his regret for having been unable to perform the duty assigned to him the previous year, respectfully presents the following facts and observations, embracing a period of six years, in continuation of a report he had the honor to submit in the year 1858.

In doing this he must first claim the privilege of expressing his acknowledgments to the few medical and scientific friends, whose names will appear in connection with their respective contributions, who have kindly given him their assistance. Without the material aid thus supplied, it would have been impossible to carry out the objects of the Association by the appointment in California, even in the present imperfect manner; for such has been the apathy manifested, that but very few and meagre responses have been received to a printed and widely distributed circular, detailing the character of the information needed, and soliciting the co-operation of medical men generally on the Pacific coast.

This indifference on the part of the profession in California to an organization, which, in its inchoate state, the sanguine Southerner[1] enthusiastically compared to "the sinking of a grand shaft into the imbedded wealth of the medical mind, from which the priceless ore, glittering with gems," was to be brought forth, cannot but be deplored, when we reflect upon the fortuitous concourse of representative medicine here met with, and the vast extent of hidden treasure waiting to be thereby opened up. Extending as California does, in its geographical dimensions, from near the 32½ to the 42d parallel, between the extremes of the rich perennial verdure of

[1] Beverly R. Wellford, of Richmond, Va.

the tropics and lifeless barren wastes of sand, between sea-levels and altitudes where forests of gigantic growth crowd upon the confines of eternal snow; with its southeastern limits stretching off towards the 130th degree of west longitude into the table-lands of New Mexico, and laved by the Pacific Ocean on the west; when we further remember that it is made up of a succession of mountain chains and culminating crests, of lesser foothills and plateaus, of fertile valleys, of *tulares*, or marshes, of arid basins as well as of well-irrigated bottom lands; when we regard California thus, and observe its position on the meteorological chart of the world, we are prepared for the admission, that, inasmuch as its climatology must be as varied as the extent and diversities of its surface, so doubtless are to be found herein involved all the various problems of life and of death, of health and of disease, which the medical philosopher is called upon to solve.

Being thus, to some extent, a world within itself, possessed as California is of every element necessary to qualify it for the fit abode of the cosmopolite congregation which is now moulding itself, by virtue of its diversified constituency and complexity of action, into a rich organic unity, it may be the "synthetic type" of Guyot, "preparing a new era." It is manifest that no better field for the study of animal life in its cosmical relations can offer than in this concentrated sphere of activity. Where else may be found the elements of climate combined in proportions so congenial to the human system, and so favorable to the development and exercise of the intellectual as well as physical powers? What results may we not anticipate in an ethnological point of view, when constituent principles, so numerous and diverse, meet and react on one another?

It cannot be expected, however, that, with the lack of co-operation and associated labor just complained of, we can enter into anything like a full, systematic reconnoissance of a country where topographical accidents and metamorphoses are exercising the most unwonted effects upon the still stranger blending of different nationalities and races. At some future day, perhaps, to conclude the metaphor above quoted, "when our shaft shall have penetrated further and deeper into its recesses; when our tunnels and adits are completed, our machinery arranged, and our furnaces in blast, the American Medical Association will proudly exhibit its ingots of mental gold, the rich results of its labors and the glorious reward of its elevated and disinterested enterprise."

The most that we can now humbly hope to accomplish is, by describing in a general manner such chorographic, climatic, and pathological phenomena as are known to be peculiar to certain regions, to convey some imperfect idea of the physical agencies recognized as capable of modifying the human constitution and its morbid developments, and thus endeavor indirectly to elucidate those obscure pathogenic influences which constitute the end and aim of all investigations like the present.

With such expectations, and under such difficulties, we venture then upon a course of inquiry which, although perhaps too vague in character and too comprehensive in range to suggest any indications by which epidemic visitations may be anticipated, or any means by which their virulence may be abated, will, nevertheless, we trust, conduct to the observation and recording of many interesting items in the domain of science. In the study and description of those natural phenomena which are supposed to be essentially concerned in the production of disease, we must necessarily treat of them as apparently isolated facts. Their relevancy may perhaps not be perceived, but isolated they cannot be regarded, for there is nothing that can be so considered in the universe. Every existence is a connecting link in the chain of being, and even "man," states Boudin, "is, in more respects than one, the mere expression of the soil on which he lives."

Writes the learned editor[1] of the *Sydenham Annals of Influenza:* "The material of mountain summits after various transformations becomes a part of the blood of animals. The coral reefs of the Pacific represent an admirable provision by which the proportions of some of the materials of the ocean are preserved. Preponderance of injurious genera in the insect world, or deficiency of others adapted for salutary offices in the economy of nature, may have no necessary connection with epidemics; nevertheless, they may yet have an indirect relation of mutual dependence on similar trains of physical change. Where we cannot detect relations of cause and effect, we may yet obtain a glimpse of truth in the study of concurrent series of phenomena. If recurring cycles of disease depend either on meteorological changes, or on disturbed conditions of life in the lower creation, however capricious, involved, and irregular such changes may appear, yet they are doubtless the result of principles as fixed as those which have been under the explanation of known physical laws. It is only by tracing the

[1] Theophilus Thompson, M. D., F. R. S.

action of each distinct cause, that we can hope to deduce the ultimate effects of the combined operation of many causes. It is probable that after protracted chains of combinations are completed, the same series of events is repeated through boundless ages; and by perseverance in exact observation, we must not despair of being able hereafter to detect certain coincidences of aspect which mark the approaching recurrence of some small portions of the general series."

We have stated that the present is a continuation of a previous report, in which we brought up our account of the topography, meteorology, and diseases of the great Sacramento valley district, from its settlement in 1849 to the year 1858. Supplementing the facts since observed, respecting this interior portion of California, and which will be found chiefly in the accompanying tables and diagrams, we now purpose taking a cursory view of those two other parallel portions of the State, known as the coast region on the west, and the Sierra Nevada on the east.

TOPOGRAPHY.

Coast Region.—The first of the two latter divisions of California just mentioned, is made up of a succession of mountains and valleys interspersed with rounded hills, and watered by numerous streams and rivers.

The mountainous portion comprises two, three, and sometimes four parallel tiers or edges, with elevations from 500 to 3000 feet above the level of the sea, and peaks occasionally rising to 5000 and even 8500 feet, as we find Mt. San Bernardino at nearly the southern limits of the State; while Mt. Shasta, on the north, towers up to 14,440 feet. These various ridges extend, although not in unbroken continuity, throughout the whole length of the State, and form its prominent chorographical feature. Mt. San Bernardino, in lat. 34° 10′, may be regarded as the southeasterly initial point of the mountain system of California. From thence we have a well-defined main ridge, named after this mountain, running west-northwesterly to another peak, Mt. Pinas, in lat. 34° 40′, for nearly 150 miles, and at an average distance of 50 miles from the sea coast. North and south of the main ridge numerous short spurs set out at right angles with their primary. The most noticeable is the Santa Susanna, running in a west by south direction and bounding the county of Los Angeles. A little further we find the mouth of the Santa Clara River, about 34° 20′ lat., and crossing the valley

we come to the Santa Inez coast range, running nearly due west for more than 60 miles to Point Conception, lat. 34° 30′.

From Point Conception northwardly the spurs or terminals of various ranges make up the greater part of the coast line; and here and elsewhere when they enter the ocean from the headlands and capes.

In latitude 35° we arrive at the Santa Lucia ridge. This ridge, like the Santa Inez, rises at but a short distance from the seashore, and extends to the small river Carmelo, a few miles from Monterey. Between the Santa Inez range and Mount Pinas, we have several noticeable features. Mount Pinas, while receiving the San Bernardino range, is also the terminal point of the Sierra Nevada, and Mount Diablo range; which latter may be regarded as the eastern limits of the coast ranges. In addition we have the Santa Barbara, or San Rafael Mountains springing from Mount Pinas, and forming the northern boundary of the Santa Inez River valley. Above this range we find the Guyamas valley and river, dividing the counties of Santa Barbara and San Luis Obispo, which also gives the name to another chain of hills and table land, radiating from the Mount Diablo range a little above Mount Pinas, in latitude 35° 20′. These trend in the direction of the Santa Lucia Ridge, which, as before stated, continues nearly to the city of Monterey.

The Santa Lucia ridge forms the southern boundary of the Salinas valley. This, the largest of all the coast valleys, being about 150 miles long by 40 broad, is bounded on the north by the Gabilan Ridge, which, at latitude 36° 10′, takes a northwestern direction, and is separated from the Santa Cruz range by the Pajaro River. It would indeed form the backbone of the counties of Santa Cruz, San Mateo, and San Francisco, but for the outlet of the Pajaro River.

Between the Santa Cruz and Mount Diablo ranges, we have the beautiful valley of the Santa Clara River, which, flowing through the flourishing town of San Jose, empties itself into San Francisco Bay. To the east of this bay the Diablo range divides itself, sending out a west-northwesterly ridge of foothills through Alameda to Contra Costa County; thence running east unites itself again to the northern tower of this chain—Monte Diablo.

Here the mountain system of Central California seems to terminate. On the west, as we have said, we have the Bay of San Francisco, on the north we have the waters of the Sacramento River enlarged to the bays of Suisun and San Pablo; and above

them the broad expanse of the Sacramento valley. On the east we have the valley of the San Joaquin; and far away still more easterly, the colossal ranges of the Sierra Nevada, which we left at Mount Pinas, and which have swept their course around, continuing to the northeastern limits of the State.

Here, then, at Mount Diablo, we leave this section of the coast range, and, crossing the bay to San Francisco, post ourselves on the rocky range of the Santa Cruz ridge. Beyond is the Golden Gate, opening from the great Pacific highway into one of the most capacious harbors in the world—about 8 miles wide and 50 long—reaching from 37° 10′ to 38°. Connected with this bay are those of San Pablo and Suisun, lying farther inland, on the course of the outlet of the waters of the Sacramento basin. The former bay, which is nearly round and about ten miles in diameter, lies north of San Francisco Bay or harbor, with which it is connected by an unnamed strait, about three miles wide. Suisun Bay, about four miles wide by eight long, lies eastward of San Pablo Bay, with which it is connected by the Strait of Carquinez, which is a mile wide.

North of the Golden Gate, or entrance to San Francisco harbor, which is about a mile in width, the Gabilan ridge reappears, and separates the Petaluma valley from the Sonoma ridge; the Sonoma valley intervening between this latter ridge and the Carneros, which is again separated from the main coast ridge by Napa Valley.

Following up the country from the north of San Francisco Bay to Bodega, we find that it is made up of low mountains from Tomales to Bodega, which assume beyond this point to Cape Mendocino, Lat. 40° 20′, a more rugged and elevated character, being but a succession of ridges and cañons, parallel to the coast, trending to the north-northwest, with occasional small and fertile valleys. From thence into Oregon the whole line of coast trends towards the north, and is, generally speaking, inaccessible, and but little known. There are very few indentations forming harbors sufficiently large for vessels of any burden, and of these Humboldt, Trinidad, and Crescent City are the most important.

Northwardly from Cape Mendocino, the western belt of the coast range is no longer found running parallel with the coast, but the country is broken up into irregular mountain ridges and rolling hills, interspersed with many very fertile valleys, watered by lakes and small streams.

Further north the ranges become so multiplied and extend so confusedly as scarcely to present a system of co-ordination. This disposition prevails particularly in that part of the chain north of Colusi, in which the counties of Humboldt, Klamath, Del Norte, Trinity, and the southwest part of Siskiyou are situated, and which collectively, form a portion differing materially in mineral aspect from the rest. The ranges here are divided by bold and rapid streams, and, as a consequence, are designated by local names, which serve to fix their geographical and relative positions; forming the boundaries of counties and lines of water-shed, which empty into the ocean at widely different and distant localities.

We have already stated that the main ridge, south of lat. 34°, is called the San Bernardino range; also that, near Mount Diablo, it takes the name of that conspicuous landmark. Now this main ridge, near the head of the Sacramento valley, becomes the Trinity ridge. This latter mountain range is important in a topographical point of view, inasmuch as it separates the waters which flow into the Sacramento from those which flow into the Klamath.

This last-named river drains into the ocean a portion of the waters belonging to what was formerly considered a part of the Great Basin, which consists, apparently, of an elevated plateau lying between the coast range and Sierra Nevada, north of Lassen's Butte; Mount Shasta being regarded as on the line of the eastern limit of the former range.

The coast mountains are steep, rocky, and rugged. Granite and analogous formations predominate in the whole range; but these have their beds like the other constituent materials of the terrestrial crust.

Professor J. D. Whitney, State Geologist, after recognizing at least three distinct periods of upheaval and metamorphic action in the coast mountains, has published the very interesting fact, that the exterior, or coast ranges nearest the Pacific, are of earlier date or older geologically than the interior ones, or those which border the Sacramento and San Joaquin valleys. This, he farther states, is a repetition on a smaller scale of what has been the course of events in the formation of the whole continent—the exterior lines having been first marked out and the interior filled up afterwards.[1]

North of lat. 38°, especially towards the interior, the mountains are more or less covered with timber and brush. South of this

[1] American Journal of Science and Art, Sept. 1864, p. 258.

point the ridges nearest the ocean have some timber, while those farther inland are nearly bare. In several parts of the entire range, between the valleys and the mountains, the rounded foot-hills are covered for many miles with a close growth of wild oats and other farinaceous grasses, affording excellent pasturage for herds of wild cattle, elk, antelope, deer, etc.

We have already mentioned the names of many of the most important valleys, in an agricultural point of view, dividing certain ridges of the coast mountains from each other. The average width of these coast valleys is about five miles at the mouth, with a length of from ten to forty miles, narrowing to a point near their head in the mountains. The Salinas valley, above mentioned, is ninety miles long, and from eight to fourteen wide. Three terraces are distinctly traceable on each side of the river. The first and lowest is about four miles wide, of a sort of rich sandy loam; the second rises with an abrupt edge, eleven feet high, and is made up of a coarse, poorer soil for two miles on each side; the third terrace is less regular in height and width, and possesses a coarser gravelly soil, scarcely fit for cultivation. This terrace formation, with its variation of soils, which was mentioned in our former sketch of the Sacramento valley, is a strongly-marked feature of most of the valleys in the State. There are some exceptions to the general co-ordination of these coast valleys and mountains. Thus, there is a low plain between Russian River and Santa Rosa Valley, which opens into Sonoma and Petaluma valleys; and again, the Santa Clara and Pajaro valleys are separated by hills not more than 250 feet high. So also the division between San Ramon and Amador valleys is so low as scarcely to be observable.

The hydrography of the coast range region is peculiar. With the exception of the Salinas, the only navigable stream south of San Francisco Bay, and the Russian, Eel, Elk, Mad, Smith, Klamath, and Trinity Rivers north of the same point, all permanent, but not all navigable, the rivers of the coast mountains, though sometimes large streams in the winters, are, for the most part, swallowed up in the sands before reaching the ocean. For example, the Santa Anna, the largest river on the southern coast, rises in Mount San Bernardino, and although in its meanderings is nearly 100 miles long, only in very wet seasons succeeds in reaching the sea. The San Gabriel sinks before reaching Monte, in Los Angeles County, and after passing three miles under ground, rises again. The intervening space where the river disappears, is very moist

sandy ground, through which the water spreads and soaks. The point at which water ceases to flow, according to Lieut. Emory,[1] "is quite variable; its more usual up-limit being marked at or near the passage of the stream from the first rocky ranges into the tertiary formation. The point, however, is by no means a fixed one: thus, during the night it extends further downward than in the daytime; in cloudy weather, for the same reason, its course is more prolonged than under a clear sky. In the stream beds themselves, however dry, water is generally found a short distance below the surface."

The rising and reappearance of the springs and watercourses in California after the drought of summer, and before the rainy season sets in, have long been the subject of popular remark. In the bi-monthly report of the Agricultural Department, U. S., for Sept. and Oct. 1864, it is stated that the same observation has been made in the Eastern States, at the close of severe droughts; and the cause is readily found in the change from dry to moist winds. There being less evaporation of the springs and rivulets, which are fed by the subsoil moisture with a uniform supply, there must be an increased volume of water in them. In California, as the wet season approaches, the power of the sun diminishes, and hence the constancy of the phenomenon. There is another feature of the scenery of our plains, observed by Dr. Henry Gibbons. "In the autumn, after travelling five or ten miles without meeting with a drop of water, or any growing vegetation, you observe a clump of green willows in the bed of what appears to be a 'dry creek.' You find there a pool of water; and, perhaps, in the course of the bed other pools will be found, where a good supply of water is always on hand in the driest season."

Among the hydrographical peculiarities Clear Lake stands out most prominently; indeed, it is the only collection of water worthy of the name of lake in the coast range district. Situated at a considerable elevation, between the 39th and 40th parallels, this beautiful mountain lake lies in a deep basin, with an outlet to the eastward, where its surplus waters are carried off by Cache Creek to the Sacramento. It is about twenty miles long, varying in breadth from two to ten miles, and is surrounded by a valley of fertile land; the vegetation of which is abundant and vigorous,

[1] Report of the Mexican Boundary Commission.

affording, during seasons of great drought, like that of 1863-4, fine pasturage for herds of cattle.

The numerous chalybeate and other springs, situated in different points of the area under consideration, next claim our attention on account of their interest and importance, especially the Geysers of Napa, and the adjacent regions which are among the most curious of the many volcanic springs here met with. The most remarkable of these *intermittent springs* are located some fifteen miles south of Clear Lake, on the north bank of Pluton River, a tributary of the Russian, which runs through a deep gorge. The scenery is described by Drs. Winslow and Bartlett as grand and sublime beyond delineation, and which nothing but some violent convulsion of the earth at a remote period could have produced.

"From a high peak,[1] we saw on the west the Pacific, on the south Monte Diablo and San Francisco Bay, on the east the Sierra Nevada, and on the north opened at our feet an immense chasm, from which, at the distance of four or five miles, we distinctly saw dense columns of steam rising. Descending, we discovered, within half a mile square, from one hundred to two hundred openings, whence issued dense columns of vapor to the height of from 150 to 200 feet, accompanied by a roar which could be heard for a mile or more. Many acted spasmodically, throwing up jets of hot scalding water to the height of 20 or 30 feet. Beneath your footsteps you hear the lashing and foaming gyrations; and on cutting through the surface, are disclosed streams of angry boiling water."[2]

Bartlett states that the action at this particular spot had subsided almost entirely at the time he visited it; but he mentions other fissures on the sides of banks and mountains, generally formed of decomposed rocks, which emit strong currents or jets of heated air and steam, with a noise resembling that of vapor escaping from ocean steamers, and likewise cavities with boiling water, which rose and fell, accompanied by a loud gurgling sound. "In one of these cavities, stones as large as an egg were in a state of commotion, presenting a curious resemblance to a pot of boiling potatoes. I held my hand fifteen inches above this boiling pot, at which distance the water scalded it. From this cavity to the running stream was just the width of my hand; though the surface of the boiling water in the cavity was about a foot from the running water."[3]

[1] Putas Mountain, also called Bald Mountain.

[2] Silliman's Journal for November, 1851.

[3] Personal Narrative, &c. By John Russell Bartlett, U. S. Commissioner, vol ii. p. 41, 1854.

We conclude our brief account of these extraordinary springs, with one more extract from Professor Shepherd: "Here may be found sulphur water precisely similar to the celebrated *white sulphur* of Green Brier County, Virginia, except its icy coldness. Also red, blue, and even black sulphur water, both cold and hot. Also pure limpid hot water without any sulphur or chlorine salts; calcareous hot waters, magnesian, chalybeate, etc., in almost endless variety. Every natural facility is afforded for either vapor, shower, or plunging baths. Where the heated sulphuretted hydrogen gas is evolved, water appears to be suddenly formed, and beautiful crystals of sulphur deposited (not sublimated as by fire), and more or less sulphuric acid generated. In some places the acid was found so strong as to turn black kid gloves almost immediately to a deep red."

It does not come within the scope of our object to enter into a fuller or more philosophical discussion of a subject so purely scientific as these springs. In support of our already expressed opinion, however, that they are the result of the sinking of cold *meteoric* water into contact with a volcanic focus, we adduce the following observation by Humboldt in his *Cosmos*:— .

"When, in September, 1759, Jorulla, in Mexico, was suddenly elevated into a mountain 1183 feet above the level of the surrounding plain, two small rivers, the *Rio de Cuitimba*, and *Rio de San Pedro*, disappeared, and some time afterward burst forth again during violent shocks of an earthquake, as hot springs, whose temperature I found, in 1803, to be 186°.4."

Whilst the importance of these springs, in a hygienic point of view, cannot be too highly estimated, they, nevertheless, sometimes prove a source of injury, if not of disease to the human constitution. During the long and excessive drought of 1863–'64, much of the water descending from the mountains, especially in the southern parts of the State, both in springs and wells, contained so large an amount of mineral substances as to affect sensibly the urinary organs of both man and beast. The cattle and sheep that were driven up into the mountains for pasturage, died in great numbers, and many of those that survived became so impoverished, and in such bad condition as to render them unfit for food. In this way, doubtless, they proved a prolific source of disease to those who were obliged to subsist upon them.

From this brief description of the coast-range region, it is in order to proceed to the next division of our subject; in doing

which we will incidentally continue to treat of the Sacramento valley in its connected relations with

THE SIERRA NEVADA REGION.

The mountain chain of this portion of California runs for about 450 miles from the San Bernardino Mountains in a north-northwesterly direction, with a varying breadth of about 70 miles, and a height of from 5000 to 10,000, and even 14,000 feet above sea level.

The western slope, which descends to a level of about 300 feet above the sea, constitutes the greater part of its whole width; for the eastern slope terminates more abruptly in the Great Basin of Utah, which is itself from 4000 to 5000 feet above the sea.

The greatest proportion of the snows and rains that visit the Sierra Nevada falls on its western slope, whence flow all the large rivers. These rivers run westward, nearly at right angles to the course of the chain, and cut it into steep hills and deep ravines, cañons and chasms.

The valleys are all so small that it is rare to see a hundred acres of level, arable land, even on the banks of the largest mountain streams. About latitude 40° the Sierra Nevada seems to divide or fork: one branch running northward, in the line of the main chain, the other northwestward to Mount Shasta. Between these two branches, and between the 40th and 42d parallels, is a succession of high table-land or plateau. The district bears a strong resemblance in many of its features to the Great Basin of Utah, with which it should perhaps be classed; and is chiefly drained by the Pitt River, or the upper Sacramento River, which starts in the northeastern corner of the State, and descending from the Goose Lake district of the Sierra Nevada, breaks through this plateau, and forcing for itself a channel through the Pitt hills, ultimately severs the Lassen's Butte, or western Sierra Nevada range from Mount Shasta. The drainage area of the Pitt River Basin equals fully 9000 square miles, and is singular in its conformation throughout. For the greater part it constitutes a high plateau, some 4000 feet higher than is attained at Shasta City, and through walls of volcanic rock, for nearly 100 miles, the river has cut itself a cañon, descending by a succession of plateaus to the western chain of the Sierra Nevada.[1]

[1] Pacific Railroad Exploration Reports, vol. vi.

As a water-shed this Pitt River Basin, by means of its greater altitude, is of nearly equal importance to the larger area running south from Lassen's Butte to the San Joaquin River; for the rainfalls and snows over its whole area are hardly less than threefold greater per mile, than the average of the more southern basin drained by the Sacramento River. Supposing, therefore, a high freshet in the southern water-shed equals three inches per day, and would produce over its whole area of 27,000 square miles, 188,179,200,000 cubic feet of water, and the same freshet equalled nine inches in the Pitt River, or Cascade range district for 9000 square miles, we should have to double the amount above stated in estimating the whole of the probable amount of water brought down by day while the storm lasted.

According to this, the two basins would yield the enormous quantity of 376,358,400,000 cubic feet of water, which would fill more than seven channels, each 400 miles long, and 500 feet broad, and 50 feet deep; or, in other words, it would require more than ten times the capacity of the Sacramento River to carry it off, without overflow; assuming the principle, as an approximation, that it may take the same time to run out that it runs in.

In its course towards the ocean, this water parts with its velocity every moment by friction against air, rocks, banks, curves, the bottom of the channel, and other resisting media—hence affording time for important changes to be effected before it reaches the more level parts of the valley.

In the region of the lower Sacramento, the rain, the filtration-water of the river itself, and the watercourses, in time of high water, do not run *into* but *from* the river, and consequently they carry off into the *tulares*, or marshes, and lowlands—animal, vegetable, and mineral matters capable of solution, suspension, transportation, and putrefaction. Hundreds of miles above the city of Sacramento, the tributaries of the river—every swollen brook, rivulet, and stream reach the larger affluents charged with these matters, which during its journey towards the south, under the influence of a hot sun, undergo great modifications. New chemical compositions and decompositions must occur—the heavier debris sinking, and mineral and other matters being newly combined. Hence every condition exists favorable to the dissipation of deleterious gases arising from the putrescible matter in the water; and accordingly we find this whole region infested with intermittents. But though loaded with detritus on reaching Sacramento City, the

river water, having undergone self-purification, becomes comparatively pure and salubrious—the more so, because the lower Sacramento is no longer a sewer to receive filth—the drainage during floods being in the opposite direction.

We have thus dwelt somewhat upon the drainage area of the Sacramento River, because we believe that it is virtually not only the chief commercial and physical feature of the great internal valley of California, but because it is probably the principal element, whether for good or for evil in its medical topography and hygiene. May not the comparative exemption from fever of the lower region of the valley be in some degree owing to the hygienic influences of this river? or to the analytically proved purity of its waters? or to its inundations during the winter and spring, and the cooling effects of evaporation from the vast expanse of overflowed land—*tulares*—during the summer?

In reproducing, therefore, these contributions, as well as the following thermometrical data relating to the physical history of the river at Sacramento, prepared by the reporter, and published in the May number of the *Pacific Medical and Surgical Journal* for 1864, it is hoped the attention of abler observers will be directed to a subject of such vital importance. The influences of inundations in both urban and rural districts deserve careful study in etiological, hygienic, and sanitarian points of view.

It will be observed that the contemporaneous temperature of the air and of well-water is also included for comparison:—

Monthly Mean Temperature.

	River.	Wells.	Air.
January	45°.00	57°.00	45°.59
February	49.75	57.33	50.86
March	50.75	57.33	54.02
April	56.00	57.25	59.45
May	60.00	60.00	63.12
June	72.00	59.00	70 35
July	74.66	59.00	73.45
August	61.33	59.00	71.03
September	70.00	59.33	68.84
October	64.66	58.00	62.56
November	49.66	59.00	53.26
December	44.66	57.00	46.79
Means of ten years,	58.20	58.18	59.91

It will be noticed in this table that the uniform temperature of well water forms a strong contrast with the changeful alterations

of the river and the air. While, however, the marked horary change in the air which is not shown by the table, is enormous, that in the river is scarcely perceptible. Neither the maximum nor the minimum in the latter is ever found as great as in the former. The nearest approximation between the river and the air occurs at sunrise, or in the night. Yet, notwithstanding the difference in maximum, minimum, horary, and diurnal, the annual mean of both, as shown in the table, is nearly the same, and coincides with that of well-water. Any marked diurnal or weekly change in the river, which, however, is extremely limited, is not so much owing to atmospheric changes as to the sudden rises and deliveries of its tributaries, more or less charged with melted snow and ice, as occurs in many other rivers. Humboldt says that for 27° latitude on both sides of the equator the temperature of the equinoctial seas is almost entirely independent of the atmosphere, being 83° to 84°; while the mean of the equatorial air is 79 to 80 degrees.

Following up the hydrographical features of the region under consideration, we find, near the sources of the Pitt River, Goose Lake and Lower Klamath Lake partly in Oregon and partly in California. Wright and Rhett lakes are situated between the two just mentioned. Farther south, and in successive order, we find Holloway, Eagle, Thalia, and Honey lakes, besides many others of smaller dimensions in this elevated region. Into the latter, Honey Lake, which is twelve miles long and five wide, Susan River empties after a course of about forty miles in an eastwardly direction from Lassen's Butte.

Besides these, there are numerous other mountain lakes, which it is not important to mention. Lake Bigler, however, now called Lake Tahoe, cannot be passed by without remark, for a geological interest is fastened upon it. There we see what so many other of the great valleys of the Sierra Nevada once were.

Situated in a valley at the eastern base of the central ridge of the Sierra Nevada, and at an elevation of some 6000 feet above the level of the sea, it is surrounded by mountains, which rise from one to three, and perhaps, in some cases, 4000 feet above the surface of its water. These mountains are principally composed of friable white granite, water-worn to that degree, that, although they are rough and often covered with rocks and boulders, yet show no cliffs nor precipices.

Their bases of granite sand rise in majestic curves from the plain of the valley to their steeper flanks. Many of the smaller

hills are but high heaps of boulders; the stony skeletons decaying *in situ* half buried in their granite *debris*. The dimensions of the lake, according to Goddard, who explored its southern shores during the State Wagon Road and Boundary Survey of 1855, and determined its extreme southern latitude at 38° 57′, and of whose description we here avail ourselves, can hardly exceed twenty miles in length by ten in breadth.

"The shores, at least of its southern coast, are entirely formed of granite sand, while a dense pine forest extends from the water's edge to the summits of the surrounding mountains, except in some points, where a peak of more than ordinary elevation rears its bald head above the waving forest. An extensive swampy flat lies on its southern shore, through which the upper Truckee slowly meanders, gathering up in its tortuous course all the streams which flow from the south or southeast. This little stream, though but of yesterday, geologically speaking, has yet carried down its sandy deposits through ages sufficient to form the five miles of valley flats, from the foot of the Johnson pass to the present margin of the lake, and still the work progresses. The shallows at the mouth of the river are stretching across towards the first point on the eastern slope of the lake, and at the same time the water level of the lake is evidently subsiding."

The deep blue color of the water, which is perfectly fresh, indicates considerable depth. It is well stocked with salmon, trout, and other fresh-water fish. A well-ordered sanitarium on the shores of this lake, with all the improved adaptations and appliances which modern hygienic science exacts, would prove a marvellous boon to both patients and doctors, especially during the summer months, when the climate of San Francisco and the coast region proves so harsh for invalids, particularly for such as have weak lungs.

Imperfect, as we are aware, this hurried chorographical sketch is, it would fail still more to convey an adequate idea of the region under consideration, were we not to allude, in this connection, to a large tract of country allied in its geology and climate to California, and now comprising the State of Nevada. Throughout its entire western side, the Sierra Nevada Mountains wall it in and separate it from the State of California. Parallel to the Sierra Nevada, and having the same trend, viz., about 20° east of south and west of north, are numerous lower ranges of mountains, covering with their intervening valleys the whole State. These mountains

have an altitude of 2000 or 3000 feet above the adjacent country, are formed with considerable regularity, and are separated from each other by basin like valleys, varying from ten to twenty miles in width, which is also about the average width of these ranges measured over their summits. Through the centre of these valleys usually runs a river or small stream, though in many instances they are devoid of running water, except perhaps a few temporary rills, caused by the melting snow or the rains of winter. Some of these valleys expand into wide-spread deserts on which not a drop of water is to be found except by digging, and even then, at only a few points, and which is generally so impregnated with the alkaline salts as to be scarce fit for use. Nevada is a desert, not so much on account of its poverty of soil, for large sections of its sage lands could be rendered fertile by irrigation, but because of its excessive droughts and want of moisture. Hence also the scarcity of its lakes and running streams; it being wholly without navigable waters. "It is a feature of the rivers that they scarcely increase in size throughout their whole length, owing, in part, to the rapid evaporation going on in the climate, and in part to the free absorption of water by the dry and porous earth. The Carson River is not perceptibly larger at Fort Churchill," states Surgeon Charles C. Furley, to whose valuable Sanitary Report we are indebted for this portion of our topography, "than at Genoa, sixty miles above, nor is the Humboldt of greater volume at its sink than two hundred miles towards its source. Another peculiarity of these rivers is, that the water constantly deteriorates as we go down them, owing to the accumulations of the alkaline substances from the country through which they flow. The waters of the Humboldt, palatable and wholesome near its head, are bitter and deleterious in the vicinity of the mines near that stream. As the season advances, the water in the streams, impregnated with alkaline salts, sulphur, etc., grows worse. In the spring and early summer, when these streams are swollen by the rains and melting snows, the water is much better than after they have been reduced by the dry season." Reverting now to the elevated plateau in the California range, we proceed to consider, more especially, the altitude of the peaks and crests, as well as some of the numerous basins found therein.

Mount Shasta, of which we have already made mention, as standing midway between the coast mountains and the Sierra Nevada, and which is connected by high mountain ridges with both of them, rises, at lat. 41° 30′, high into the region of perpetual snow. Its

height as already given, was fixed by Professor Whitney, at 14,440 feet above sea-level, and it was supposed to be the highest mountain within the limits of the United States.

More recently Professor Brewer, in the prosecution of the geological survey in the southern part of California, has discovered that the crest of the Sierra rises very high for a distance of more than 100 miles, and that between the head-waters of the King's and Kern's Rivers (lat. 36° 3′ to 37°) the culminating mass occurs. The highest peak is probably 15,000 feet high. One of the surveying party, Mr. King, reached the height of 14,729 feet. This fact was unsuspected before, and makes these mountains the highest in the United States.[1]

One of the prominent features of the California range, to which we have alluded, is found in the numerous basins: these afford irrefutable evidence of their volcanic origin; being only so many old craters. In 1848, Fremont, for the first time, laid down on his map the Great Basin of Utah, then a portion of California; and it was at the time supposed to be the only topographical feature of this character within the compass of North America. Further explorations, however, have since shown that many of these basins are found within, as well as to the south of our ancient frontiers—the most important of which we have only time to touch upon. The great Utah Basin itself contains innumerable imitations of its general features within its own capacious bosom, and all its streams flow towards a central line of concavity. Bounded on the north by the basin of the Columbia, on the southeast by the basin of the Colorado, and on the southwest by the Sierra Nevada and San Bernardino Mountains, this elevated tract of land, most of which is 5000 feet above sea-level—mountainous, barren, and cheerless, with no outlet for its waters—extends into California, including a district about 200 miles long and 100 wide, towards the southeastern portion of the State. This arid and most sterile region is cut up by innumerable ridges of bare, rocky mountains, with intervening valleys of sand and volcanic scoriæ. Here and there occasional springs and little streams, terminating in lakes, are met with, presenting after heavy rains a wide extent of muddy saline water, and, in the dry season, wide beds of dried and cracked mud—covered with a white alkaline efflorescence. The chief stream in the Californian portion of this great basin is the Mojave, which rises on

[1] American Journal of Science and Arts, January, 1865.

the northern slope of the San Bernardino range, and, after running about 100 miles in a northeast direction, sinks in the sand. After sinking, it rises again—or rather pools of water are found in the low places of its bed; the water evidently soaking through the sand and following the bed of the stream: a characteristic of most of the rivers of this region. Nearly on the parallel of the southern rim of the Great Basin is Owen's Lake, into which the river of the same name drains, after running southward about 75 miles along the eastern foot of the Sierra Nevada. About 100 miles north of Owen's Lake is Mono Lake, sometimes called the "Dead Sea of California," the water of which is so heavy with saline substances, that the human body floats in it, and no fish are found therein. While the greater part of the Utah Basin is high above, there is a portion of it, called "Death Valley," said to be some 300 feet below the level of the sea. It is situated at the southern watershed of that basin of deserts, where the slope from the crests of the Kern River Mountains looks east-southeast, and connects in table land bluffs, peaks, etc., with South Sierra Nevada of Tejou. Although looking from the gulf in the south, this elevated region seems high, it is merely on a level of some 3 to 4000 feet, whereas, coming from the ocean to the Sierra Nevada crests, the ascent in 100 miles is as much as 10,000 feet. This difference is remarkable; for while, as has already been stated, the eastern descents of the Sierra Nevada (and especially is this so in the locality of Lake Tahoe) are very steep, still in crossing the low divide, parallel with the Armagosa from the south, you ascend gently and descend as gently into the edge of the inner cup. The Armagosa is included near the junction of Tulare and San Bernardino counties, where the Bernardino ranges, and the volcanic sierras infringe upon the Colorado, and shut off or press in a number of singular basins or craters, which are all separated from each other, and of lessening magnitudes as they narrow southward towards that of Cariso Arroyo. This district, as exhibited on the latest maps, between the parallel of Owen's Lake and the New River of the Colorado, may be compared to the figure of a pear, with the largest end towards the northeast, and the small end towards the southwest. It is one of the most desiccated arid districts on the face of the globe, and its aspects are most dreary and melancholy. Its extreme length from the Dead Sea parallel to Cariso is estimated at 300 miles—the Death Valley, with the 300 mile Big Cañon of the Colo-

rado, situated therein, being among the geographical wonders of North America.

The last of the districts in this connection to be noticed is the *Colorado Desert*, about 70 miles wide by 140 long, situated at the southeastern border of California, and belonging to the basin of the Colorado River. It is called a desert because of its barren, sandy soil, and scanty vegetation—thorny cacti and arid shrubbery, such as the *Larrea mexicana*, *Fouquiera splendens*, etc., usurping the soil. In Emory's "Report of the U. S. and Mexican Boundary Survey," Dr. Parry states: "On leaving the last rocky exposures to enter on the open desert plain, we pass some distance down the bed of Cariso Creek; along the course of which are exposed the high bluffs of sand, marl, and clay, exhibiting a fine sectional view of the tertiary formation on which the desert plateau is based. At the point where the road leaves the bed of the creek, to mount to the desert table-land, some 150 feet above, fossil marine shells of *ostrea* are found, and gypsum makes its appearance in extensive beds. The upper layer of the table-land shows a variable thickness, composed of water-worn pebbles, derived from the adjoining mountains. Near the mountain base, this plateau has a height of about 500 feet above the level of the Colorado River. The surface extends in a gentle slope towards the Colorado, or eastward, about the distance of 25 miles, where it reaches its lowest depression at the Lagoon or 'New River' Basin, which is in fact a part of the extended alluvial tracts belonging to the Colorado River. The proof of this latter fact is seen in the barometric observations, showing a depression at this point, below the level of the Colorado River in high water, and also by tracing a direct connection between the overflow of this latter stream and the appearance of water at New River." A singular matter connected with the Colorado River, since the American settlement of California, is that *a river was made in the desert,* by the heavy rains and snows from Dec. 1848, to Jan. 1852, called "New River," which forced back the overflowing of the Colorado into a basin and dry river bed, some hundred miles or more toward the northwest. The connection of this basin with the New River lasted several years, when its mouth was again blocked up by drift and sand bars from the Colorado, very likely assisted by the then prevalent earthquakes of that district. It is supposed that at one time the Gulf of California extended several hundred miles further north than it now does, and the Colorado River in long ages deposited so much allu-

vium as to make banks down to the present head of the gulf—thus cutting off from its connection with the ocean that part of the gulf now dry. As the evaporation in this desert far exceeds the fall of rain—so it was not long before this lake was dried up. In lat. 30° 20′, and long. 115° 50′, is found a portion of the desert, about 30 miles square, or more, which is estimated to be about 70 feet below the level of the sea. In this locality some remarkable mud volcanoes are to be seen, covering a space of about a quarter of a mile long and an eighth of a mile wide. This area is of soft mud, through which hot water and steam are constantly escaping. The vapor rises steadily in some places, with a hissing noise; in other places it bursts out with the noise and action of an explosion, throwing mud a hundred feet into the air with a loud report. Some of the springs are surrounded by incrustations and arborescent concretions of carbonate of lime—others are encircled by deposits of sulphur. There are places where the mud is in constant movement and rises in great bubbles, bursting, as if boiling from intense heat; while in other places regular cones, apparently hardened into permanency, have been formed into shapes varying from low hillocks to sharp points. The whole earth is soft in this vicinity, and frequently the crust is broken and thrown up with great violence to establish new springs, steam-vents, and mud-cauldrons—consequently it is not safe to approach too near. The air blown from the valves is fetid with sulphur.

Besides these solfataras, and the geysers, in Sonoma, already mentioned, there are several places in California where, from the heated earth, sulphurous gases and vapors are always escaping. In the northeastern part of Plumas County there are a great many hot springs covering an area of ten acres. Their hissing and noise can be heard at the distance of a mile, and their steam can be seen for a greater distance. The whole place smells strongly of sulphur, which mineral, as well as alum and various earthy salts, abounds. It was rumored in 1858, that there was an active volcano in Plumas County, near Lassen's Peak, but there was no satisfactory proof of the truth of this report; though there is a portion of country in that vicinity of which very little is known. About one hundred yards west of the summit of Mount Shasta there are about a dozen steaming hot sulphur springs, and the earth about them is so hot as to be unpleasant.

Geologically considered, California belongs chiefly to the palæozoic and tertiary formations. Carboniferous rocks have as yet

been discovered to a very limited extent. A tertiary sandstone, some of which is metamorphic, having apparently lost its original stratification under the influence of intense heat, underlies the valleys of the Sacramento and San Joaquin, and of the coast, and is also found in the Coast Mountains, the Great Basin, and the Colorado Desert.

About Mounts Shasta and Lassen, Castle Peak, the Marysville Buttes, in the plateau of the Sierra Nevada, the Great Basin, the Colorado Desert, and other points, there are considerable tracts of basalt, lava, trap, trachyte, etc. Along the sides of the Sierra Nevada, near the line of separation between the sandstone of the valley and the granite of the higher parts of the mountains, are found various other rocks, among which slate, quartz, and limestone are prominent. Some coal, much of it a lignite, has been found in various parts of the coast region.

The limited time at our command will not permit us to enter into the further consideration of this subject, or any other of a kindred nature, such as the mineralogy, flora, fauna, ethnography, etc., usually discussed in reports like the present. To the Climatology and Epidemiology, which are more immediately connected with pathogenetic medicine, we now purpose confining our special attention.

The total area of the whole region, which we have endeavored to describe in this general manner, amounts, according to the estimate made by Hittel (of whose work on "The Resources of California" we have freely availed ourselves), to about 155,000 square miles; of which there are 42,000 in the coast mountains and valleys, 40,000 in the Sierra Nevada and its plateau, 20,000 in the lowland of the Sacramento Basin, 30,000 in the Great Basin of Utah, 15,000 in the Colorado Desert, and 8000 in the Klamath Basin; the last estimate of 8000 miles falling below our computation.

CLIMATOLOGY.

In the former report, already referred to, our object was to establish in the first instance, as far as the nature of the case permitted, the meteorology of the capital of the State, and which subsequent data, presented in the accompanying tables and diagrams, have confirmed—Sacramento being so centrally situated, as to

represent with an approximative accuracy the whole of the lowlands of the great interior basin. We say *approximative*, because, although the tendency of errors and accidents to balance each other authorizes us to entertain the greater confidence in the conclusions drawn from such tables, still it is in the highest degree probable that they would be much modified by more numerous series of observations at different stations within the area thus represented. Indeed, when we reflect that a thermometer, removed but a few hundred yards from its first position, differs not unfrequently five, sometimes even ten degrees, in its readings; and that the annual fall of rain on the roof of the Observatory at Paris is two inches less than on the ground by the side of it, we see at once how very imperfectly acquainted we are with the means and extremes of temperature, or the precipitation and the evaporation—the climate, in short, of any extensive region on the face of the globe. And if such is the case, as the progress of science has actually demonstrated respecting countries most densely peopled, and best supplied with instruments and observers, how inaccurate, in a strictly scientific point of view, must be deductions, drawn in California especially, from points so widely apart, such as we are necessarily confined to at this time.

Perhaps in no other part of the world will there ever be found such a multiplicity of climates curiously pitched together, at short distances, one from another, as are here met with. In the three parallel strips, into which we have divided up the State, for the purpose, if possible, of some sort of systematic description, subordinate local differences of climate, the most remarkable, are found resulting from subordinate features in the local configurations—particularly in the seaward strip or portion. Thus we find in the western slope of the coast range, between Point Conception and Cape Mendocino, a multiplicity and confusion of climates almost indescribable. South of Point Conception quite a different character of climate obtains. So with the elevated Sierra Nevada and Klamath basins and plateaus the climatic features are totally changed; while the climate of the Great Basin of Utah and the Colorado Desert are as distinct from each other as they are from all the others.

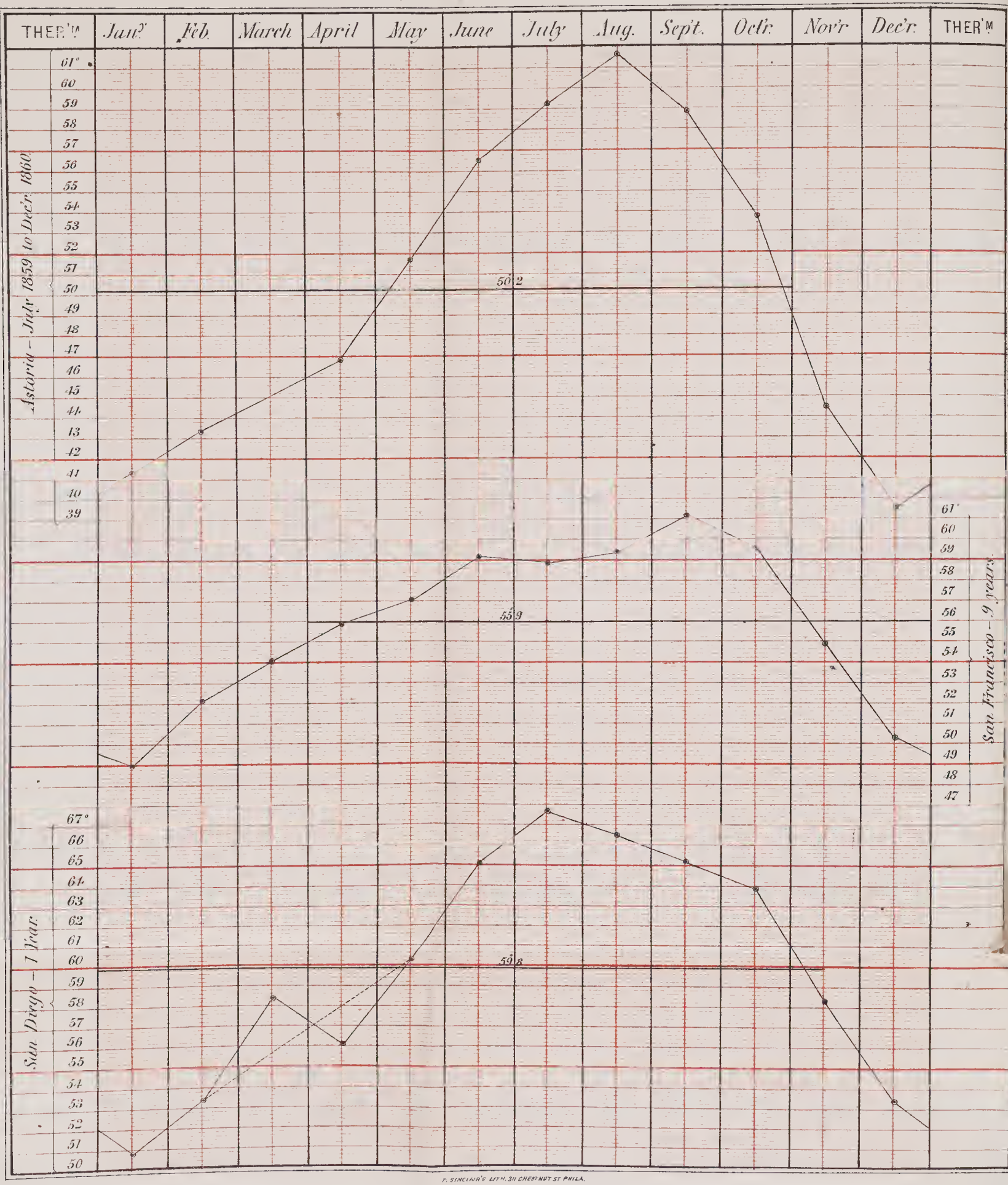
The immediate efficient cause of these complex atmospherical conditions has so little direct connection with the effects of latitude and altitude and the defences of mountain ranges, that it will only be necessary to refer generally to those topographical peculiarities

already described, which from their prominence seem to suggest a causative relation. The most obvious hypothesis would attribute it to a causation, which is probably itself the co-efficient of two elements—the sea-winds and the temperature of the land-air—the properties of the one, and the conditions of the other. With respect to the former of these two elements, the sea-wind, observation and experience point to a deep sea current from the polar regions of great magnitude and volume, which appears only by the lifting of its waters on approaching the coast of California, and in the general refrigeration of the waters of the whole area.

The body of water affected, as shown by Maury's Charts, extends northwestwardly towards the peninsula of Alaska, and is found strikingly uniform in its characteristics of low temperature, absence of surface currents, and continuous northwest winds. This great mass of cold waters, and its attendant cold surface atmosphere develop a strong sea wind towards the heated and rarefied interior valleys and plains, and where these contrasts of temperature are greatest, the maximum effect is produced as at San Francisco.

This hypothesis, attributing the community of causation of the coast climates to the temperature of the land air and that of the water of so large a portion of the ocean is further sustained by the fact, that the contrasts which induce these violent sea winds exist only in the summer months, including May and September, as at other seasons the temperature of the ocean is raised by a warm current flowing across from the China Sea, while the land becomes colder; and whatever the degree of aridity, the sudden and extreme rarefactions do not occur in the interior. The spring and autumn are, therefore, both warmer than the summer on the immediate coast. In the winter, the reverse of all this takes place. The sierras are now covered with more or less snow, which extends down to their bases, whitening also not seldom the great valley which has become colder than the coast region; while the southeast trades, charged to their utmost capacity with moisture, commence descending as their temperature decreases, and precipitate more and more rain as they become chilled by the cold northerly winds. During the summer, owing to the fact of these polar breezes passing over a highly heated and arid surface, their temperature is raised, thereby increasing their capacity for moisture, which not being able to obtain from the surface passed over, they appear as dry winds, reminding us of the reputed sirocco of Italy. Dry, however, as these winds apparently are, on coming in contact with the westerly

THERMOMETRIC CURVES FOR ASTORIA, SAN FRANCISCO & SAN DIEGO.



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winds chilled by the oceanic polar current, and their temperature being again reduced, the vapor they contain is rapidly condensed; hence the heavy mists that are precipitated during the afternoon at San Francisco and at the gaps along the coast.

With the understanding of these facts, the varieties and anomalies of the California climates, especially of the coast, will become more intelligible; so we now proceed to the discussion of the meteorology of San Francisco and its surroundings as the type of the first division of our subject.

SAN FRANCISCO AND COAST CLIMATES.

San Francisco does not lie immediately on the ocean, but six miles from it, in the bay of the same name, as has been already stated, where there is a great gap, the Golden Gate, which gives free admission to the sea winds and attendant fogs or mists. This bay is a large salt-water lake in the middle of a much larger land lake, sometimes called the San José valley. It extends south of the city some forty miles, and northward about twenty-five more, if we include San Pablo Bay. Now the smaller valleys opening into this larger valley of the bay, in fact, most of the valleys embosomed in the coast range already described, though having each a peculiarly modified climate of their own, and productions corresponding, all partake more or less of the characteristics of the climate of San Francisco, the shades of difference being caused by the great equalizing power of the ocean and the greater or less exposure to it. The Pacific winds are very nearly calculable quantities, and by them are determined to a great degree the temperature of places, the rains, the growths also, as respects both their rates and kinds, and the almost uniform salubrity. The nearer the Pacific, the denser and more frequent the fog, the stronger the winds, the warmer the winters, and the cooler the summers. In fact every degree of temperature, from the heat of the torrid zone to a chilling cold, can be found at short distances from each other near the level of the sea.

Sacramento is eighty miles from the ocean, Benicia forty, Napa thirty-five, Sonoma thirty, Petaluma twenty, San Rafael ten; and according to their respective distances from the ocean is the climate of each of these places graduated in the summer. At Sacramento the influence of the sea breeze is sometimes wanting, and then the weather is oppressively hot; but Sonoma valley, while far enough off from the ocean to escape the fogs and cold blasts which prevail

at San Francisco, enjoys just enough of the sea breeze to temper the heat of every summer day to the right standard for comfort.

As with the general course of water in a river, there are many abrading surfaces, irregularities, etc., which produce a thousand eddies in the main stream, yet, nevertheless, the general direction of the whole is not disturbed nor affected by those counter-currents, so does it appear to be with the oceanic winds in these regions. We have only to observe further, that the east side of any of these coast valleys will be commonly much warmer than the west; for, paradoxical as it may appear, the sea wind always blows much harder on the side of a mountain opposite or away from the wind, than it does on the side towards it. The reason of this is that the cold wind of the ocean being once lifted over the sea wall mountains, and being specifically heavier than the atmosphere into which it is driven, no sooner passes the summit, than it pitches down as a cold cataract, with the uniformly accelerated motion of falling bodies. A remarkable instance of the great contrasts of climate at short distances is found between Benicia and Martinez. These two places are only a mile and a half apart on opposite sides of the Straits of Carquinez, which connect the Bay of San Francisco with the Bay of San Pablo. The sea wind, rushing through the Golden Gate, sweeps along the Contra Costa, or second range, full in the face of Benicia, while at Martinez, close under the end of the mountain, which has turned the wind directly by, all the characters of the climate of the Sacramento valley, whose rim, it may be said, is here, are found to obtain.

"Equally plain, now," says an intelligent traveller,[1] "is the solution of those apparent inversions of latitude, which at first perplex the stranger. In the region about Marysville, for example, he is overtaken by a fierce sweltering heat in April, and scarcely hears, perhaps, in the travel of a day, a single bird sing as if meaning it for a song. He descends by steamer to San Francisco, and thence to San José, making a distance in all of more than two hundred miles, where he finds a cool, spring-like freshness in the air, and hears the birds screaming with song even more vehemently than in New England. It is as if he had passed out of a tropical into a temperate climate, when, in fact, he is due south of Marysville by the whole distance passed over. But the mystery is all removed

[1] Horace Bushnell, D.D., to whose philosophical account of the climate of California we here acknowledge ourselves much indebted.

by the discovery that, instead of keeping in the great valley, he broke out of it through the Straits of Carquinez into the bay valley and the cold-bath atmosphere of the coastwise mountains, that now he is in fact within twenty miles of the sea, separated from it only by a single wall, while at Marysville he was more than a hundred miles from the sea, with four or five high mountain tiers between."

To proceed with our type of the coast climates: San Francisco, which is on the same parallel with Washington and St. Louis, has neither the cold winters nor the hot summers of the latter places; and this is true also of the entire coast between 35 and 40 degrees of latitude. In the tabulated series of thermometric monthly means it can be readily computed that the mean temperatures of spring, summer, autumn, and winter, at San Francisco are 55°, 59°, 58°, and 50°, respectively; showing a difference of only nine degrees between the average of winter and summer — whereas a similar comparison of the temperature on the same parallels of the Atlantic coast shows a difference of between 35° and 40°. There is a range of three degrees more in San Francisco by taking the months separately: January, the coldest month, having a mean temperature of 49°.9, and September, the warmest, a mean of 61°.1. October is warmer than July and August, being 59°.5, 58°.8, and 59°.3, respectively; while the mean temperature of the year is 55°.9. The lowest point to which the thermometer has ever fallen was 22° in January, 1862; while in St. Louis, it descends to 12° every winter, and frequently remains near that figure for many consecutive days. The coldest winter days, at noon, are as warm as the warmest in Philadelphia. On the other hand, the summers are comparatively quite cool. In November, 1854, the lowest reading of the thermometer was 47°, while in July of the same year it was 46°. Showing that at no time of the former month was it so cold as at one time in the latter. The mean temperature of July is 57°, and there are not more than a dozen days in the year when the thermometer rises above 80°. The average range of the thermometer in July and August, is about 20°—from 50° to 70°. Once only the thermometer rose to 97°, and as it often falls to 46° in July, such a range of 41° might occur within 12 hours. No matter, however, how warm the day is, the evenings and mornings are always cool; and this is generally the case throughout the whole State. On an average, in California, the atmosphere remains free from clouds for two-thirds of the year, but near the sea coast, clouds

are frequently blown up from the ocean. In June, July, and August, heavy, wet, cold mists come up to San Francisco, from the sea at six o'clock in the evening, and continue until eight or nine next morning. In the winter, fogs are rarer, and do not commence so early in the evenings. Writing of the fogs and mists at San Francisco, Dr. Henry Gibbons, says:[1]—

"It is curious to observe the conflict between the absorbing power of the air and the supplying power of the ocean, in regard to moisture. Towards noon, when the wind rises, huge columns of mist may be seen piled along the coast, three or four miles west of the city, and pouring in like a deluge upon the land. But the air of the land, which is always thirsty, drinks it up with astonishing avidity, so that the impending wave, though in a current moving from thirty to fifty miles an hour, makes slow progress. By the middle of the afternoon it is within a mile or two of the city, and there it stands like a solid mass of water several hundred feet in depth, rolling and tumbling towards you, not without grandeur and majesty, and threatening to overwhelm you in a few seconds. You await its coming, but it comes not; it even recedes, to return and recede again. Not until the sun has lost his calorific power does the atmosphere reach the point of saturation; and then, towards sunset or later, everything is submerged by the vapory flood. In the course of the evening the wind falls. During the night the mist is gradually dissolved and disappears from the lower stratum of air, while it forms a heavy cloud above. About the middle of the forenoon the cloud is dispersed by the rays of the sun. The dispersion is rapid, the sky often becoming entirely clear in less than half an hour.

"If it be possible to distinguish between fog and mist, regarding the former as impalpable, and the latter as composed of palpable particles of moisture, I may remark that mist belongs only to the summer, and fog to the winter climate of San Francisco. There is no mist in winter, and no fog in summer. At all seasons the drying tendency of the atmosphere is observable. You notice none of those phenomena which in other climates depend on an excess of water in the air, and on sudden changes of temperature. The moisture does not condense on your windows, nor on the plastered walls; salt does not liquefy, nor even exhibit the slightest dampness; and the housewife has no trouble in drying her clothes,

[1] Transactions of the 3d Session of the Medical Society of the State of California.

provided it should not rain. In fact, the atmosphere of San Francisco, in spite of sea winds and mists, is a dry atmosphere."

The general course of the coast of California is, going southward, from N. N. W. to S. S. E.; but at lat. 35° it turns due south, and, after keeping that direction for forty miles, makes a right angle and runs due east eighty miles. Along the southern side of this angle runs a high mountainous spur, which, projecting into the ocean at Point Conception, seems to protect the coast south of it from the fogs, which are much warmer and rarer in this direction. The summers too are much warmer than on the coast to the northward of it, but the sea-breezes are regularly felt, as shown in the thermometric table for San Diego, and they protect the whole country to a distance of fifty or sixty miles from the ocean against the excessive heat which reigns in the Colorado Desert. The winters, however, are nearly as cold as on the coast further north. Los Angeles, in lat. 34°, is at times as cold in winter as San Francisco in lat. 37° 48′, because it is farther from the ocean and is in sight of Mt. San Bernardino and other high mountains, some of which are capped with snow during a great part of the year. In the tabulated thermometric series it will be perceived how the cold oceanic current attempers the summer climate over a great extent of coast, while the extremes of summer heat are common to all the valleys, where the mountain ranges intervene between them and the Pacific. Blodgett states that the isothermal of 57° is found to extend along the coast from Sitka, in Russian America, to Monterey, giving an almost absolutely equal temperature for this extensive line of 1500 miles of latitude and near 2000 miles of coast.

A brief period of observations on the coast of Oregon shows the temperature higher; which, if substantiated, may prove the position of the cold line to be a little distance off that coast at sea:—

TABULATED SERIES OF THERMOMETRIC MONTHLY MEANS WITH THE VARIATIONS THEREFROM.

Sacramento, for 9 Years, 1856–'64.

The results of the observations at this station afford an approximate standard for estimating the climate of the immense Sacramento and San Joaquin valleys, which may be called a single valley, the meteoric condition of which varies as little as its geographical formation. The exposure is locally over low plains, with much surface water, in the centre of the wide interior valley.

Months.	7 A. M.	2 P. M.	9 P. M.	Mean.
January	—3°.8	+3°.6	+0°.2	46°.9
February	—5.0	+4.5	+0.5	50.4
March	—5.0	+5.0	−0.1 / +0.1	55.0
April	—4.9	+5.5	−0.6	59.8
May	—4.0	+5.8	—1.8	64.0
June	—4.6	+6.6	—2.0	69.7
July	—5.0	+7.0	—2.0	72.9
August	—5.4	+6.9	—1.5	71.3
September	—6.8	+7.3	—0.5	68.6
October	—6.7	+6.9	−0.3 / +0.1	61.8
November	—5.8	+5.7	−0.2 / +0.3	53.3
December	—3.8	+3.8	−0.2 / +0.2	46.9
Sums	—60.8	+68.6	+1.4 / −9.2	720.6
Means	—5.0	+5.7	+0.1 / −0.8	60.05

San Diego, for 1 Year.

This station is situated at the head of a valley six miles northeast from the old Presidio, and eight miles from the sea-shore; latitude 32° 42′; longitude 117° 14′; altitude 150 feet. The valley opens upon the plain extending to the town and shore hills, of 250 feet elevation, bordering the valley and a range of mountains lying about fifteen miles east. Position from Lieut. Williamson's survey map, 1855, based on Boundary Commission and Coast Survey positions for San Diego.

As shown on the draft of the curve the means for March and April seem erratic.

Months	7 A. M.	2 P. M.	9 P. M.	Mean.
January	—6°.4	+7°.1	—0°.8	50°.6
February	—5.7	+7.0	—0.3	53.3
March	—4.2	+7.1	—2.9	58.3
April	—3.3	+5.5	—3.1	56.0
May	—1.4	+4.7	—3.3	60.2
June	—2.2	+5.3	—3.0	65.0
July	—2.1	+5.5	—3.3	67.6
August	—1.5	+4.7	—3.3	66.5
September	—2.3	+5.3	—3.1	65.0
October	—2.2	+4.9	—2 6	63.9
November	—4.0	+6.1	—2.0	58 2
December	—6.5	+8.4	—2.2	53.3
Sums	41.8	71.8	29.9	717.9
Means	—3.5	+6.0	—2.5	59.8

San Francisco, for 9 *Years,* 1855–'63.

As Sacramento is the type of the climates of the interior valley regions, so does San Francisco bear the same relation to the entire coast of California from Oregon to San Diego. Although six miles from the ocean, the sea wind blows into the bay, in which it is situated, through the gap at the Golden Gate, like through a funnel, with increased intensity. As shown in the curve, the temperature during July and August is abnormally low on account of the fogs which prevail during that period in excess.

Months.	7 A. M.	2 P. M.	9 P. M.	Mean.
January	—3°.2	+3° 7	—0°.5	49°.9
February	—3.8	+5.2	—1.4	52.1
March	—3.9	+5.9	—2.1	54.0
April	—3.2	+6.4	—3.1	55.8
May	—2.6	+6.4	—3.8	57.0
June	—2.7	+6.9	—4.3	59.0
July	—2.8	+6.7	—3.9	58.8
August	—3.3	+7.1	—3.8	59.3
September	—3.5	+7.8	—3.4	61.1
October	—4.0	+6.3	—2.4	59.5
November	—3.5	+4.7	—1.2	54.8
December	—2.8	+3.5	—0.7	50.2
Sums	—39.6	+69.6	—30.0	670.8
Means	—3.3	+5.8	—2.5	55.9

Astoria, for 18 *Months, July,* 1859, *to December,* 1860.

The station is at the town of Astoria, Oregon; latitude 40° 11′; longitude 123° 48′; altitude 50 feet, on the south bank of the Columbia River, ten miles in a direct line from the Pacific. The locality has a free exposure over water surface and low plains to the sea, with rough hills at the south and east. Position from United States Coast Survey, 1853. Although the effect of the cold sea winds is strikingly shown at the 2 P. M. observations, still the difference between the hot and cold part of the day is seen to be much less than in the stations further south.

Months.	7 A. M.	2 P. M.	9 P. M.	Mean.
January	+1°.5	—1°.3	—0°.3	41°.3
February	+2.2	—2.9	+0.6	43.3
March	+3.9	—4.4	+0.5	45.3
April	+2.4	—4.0	+1.5	46.8
May	+2 4	—3.6	+1.1	51.7
June	+1.9	—3 3	+1.5	56.5
July	+2.1	—3.5	+1.4	59.2
August	+2.4	—3.9	+1.5	61.6
September	+2.7	—3.8	+1.2	58.9
October	+2.6	—3.3	+0.8	53.7
November	+1.9	—2.4	+0.5	44 3
December	+1.9	—2.1	+0.2	39.5
Sums	+27.9	—38.5	+10.5	602.1
Means	+2.3	—3.2	+0.9	50.2

CLIMATE OF THE SIERRA NEVADA REGION, &c.

In proceeding now to the consideration of the climatology of this division of our subject, it is necessary to premise that the instrumental data we possess are too limited to afford anything like positive deductions respecting so extensive a region. All that we can hope to accomplish is to describe in some general manner the various climatological distinctions, which we have already stated as existing between the different parts embraced under this general heading. There is one feature, however, of the distribution of the temperature, which is well established and positive, and that is the *great excess of heat for the altitude* of this region as a whole. According to Blodgett, the isothermals often continue their direction across the elevated region, without sensibly changing their position in latitude, as they approach it from the low plains at the east, or from the ocean on the west. But although the heat of summer at midday is almost as great as in the Sacramento valley, and even sometimes insupportable from the reverberation in deep cañons, it is nevertheless qualified by altitude and severely cold winters, while the amount of precipitation is greater in proportion to elevation. A gentle west wind, heated in the lower parts or foot-hills by the heat of the great valley, fans it all day. At points which are higher, the wind is cooler. The nights, too, are always quite cool in summer; so cool, that the late and early frosts in many districts leave too short a space for the ordinary summer crops to mature, even where the altitude is not more than 3000 to 4000 feet. At the summit of the sierra, the west wind, piling up from below, breaks over with accumulated force into Utah. "A traveller's tale" is, that it blows with such stress in some of the passes as even to polish the rocks by the gravel and sand which it drives before it. The day is cloudless on the slope of the sierra as in the valley, but on the summits there occur, sometimes, severe thunder showers. With this exception, thunder is very seldom heard in any part of California. The winters, as just stated, are very severe. In places 3000 feet above sea level, ice forms five or six inches thick, and snow, deep enough for sleighing, lies several weeks nearly every winter. In towns, 6000 feet above the sea, snow falls from five to ten and even fifteen feet deep, and covers the ground five or six months in the year.

The following means of the thermometer for the coldest and hottest months at different altitudes, kindly furnished by Major

Williamson, U. S. A., afford the only positive knowledge of the climate of this section that we can obtain:—

Stations.	Altitude	July.	January.	Range.
Aurora	7.468 feet	68°	26°	42°
Hope Valley	7.088 "	55	26	29
Strawberry Valley	5.710 "	60	36	24
Fort Jones	2.570 "	71	31	40

Aurora, the southernmost of these stations (lat. 38° 12′), has been found by the late boundary survey to be about three miles within the new State of Nevada. It is situated upon a beautiful flat formed by the conjunction of two ravines, which come down from between Silver, Middle, and Last Chance hills. The observations at Fort Jones, the northernmost station (lat. 41° 36′), are obtained from the *Army Meteorological Register*. It is situated in Scott's Valley, on a small tributary of the Klamath River, nearly one hundred miles from the head of the Sacramento valley, and an equal distance in a direct line from the Pacific coast. The locality is not closely confined, though it has high mountains, the Siskiyou and Salmon ranges, on the south and east.

The above remarks and measurements of temperature apply more particularly to the higher latitudinal portion of the Sierra Nevada range, including the elevated plateaus of the Klamath and Pitt River regions, etc. In the more southerly part of this remarkable mountain system, and especially below Mono Lake and the head-waters of the San Joaquin, quite a different order of climatic features present themselves. Here the general character of the vegetation has obtained for these mountains the title of "the Alps of California," but their homologue is rather found in the Arctic zone than in Switzerland. In the Swiss Alps, trees are not found more than 6,200 feet above the sea. According to *Johnston's Physical Atlas*, the pine, the larch, and the common fir cease at successive stages to the elevation of 5,900 feet; one of the Coniferæ only, the *Pinus lembræ* is observed sometimes to advance 300 feet further. In the Californian Alps, trees reach to 11,000 feet.

In an interesting account of Prof. Brewer's explorations, published in the *Mining and Scientific Press* for October, 1864, it appears that good pasturage reaches from 5,000 to 10,000 feet above sea level, and even higher, up to the very crests of the peaks. It consists in about equal shares of the true grasses and the sedge grasses, and is extremely nutritious. At 3,500 feet above sea level,

the dense forest begins. The trees are mostly sugar and yellow pine, Douglass spruce, fir, and bastard cedar. Along the western slope, at an altitude of 5,000 to 7,000 feet, the "Big Trees," or giant *Sequoias*, are abundant, not merely occurring in isolated groves, as is the case further north, but scattered abundantly in common with the timber for a distance of at least twenty-five miles along the tributaries of Kings, Kawcah, and Kern Rivers. Larger trees are met with here than in the celebrated Calaveras and Mariposa groves. The largest reported is about forty feet in its greatest diameter.

Besides the arctic character of the vegetation just alluded to, it would seem that the entomology is so likewise. The red snow, also, peculiar to the arctic zone as well as to the European Alps, is also found. It is not snow, but little globules, intensely red in color, which are so abundant as to give a red tinge to a large mass of snow. M. Pouchet, in conducting some interesting investigations with regard to spontaneous generation, has found in snow collected on the top of Mount Blanc, at an altitude of 12,104 feet, specimens of the *Protococcas nivalis*. It is highly probable, therefore, that this redness of the snow is due to microscopic animalculæ.

Recurring now to the higher latitudinal portion of the mountain system under consideration, we find, on the eastern slope, that the new State of Nevada has its wet and dry season just like California, except an occasional interruption of the latter season by showers. Dr. Farley, already cited as authority, when describing the topography of this district, states that the winters are uncertain and variable, the thermometer often falling to ten and twelve degrees below zero, though it is not apt to remain at so low a point for more than a few days at a time. During the months of June, July, and August, the thermometer oscillates between 75 and 100 degrees. "The amount of stormy weather experienced is small compared with the Atlantic States or even California. Yet the snow upon the mountains falls to a great depth, especially upon the main sierra, where it often lies from fifteen to twenty feet deep, remaining until late in the months of May and June, and upon the north slope and some of the higher peaks all summer. In the valleys it rarely falls to a greater depth than one or two feet, and seldom lies more than a few weeks at a time. The further the valleys are removed from the Sierra Nevada range, the smaller the amount of snow and the shorter time it remains upon the ground. Some of the more sheltered valleys in the interior are nearly free from snow the year round, or, if it falls occasionally, it never accumulates

beyond a few inches, and melts in a day or two. During the fall and winter months, the whole country is subject to violent winds, which at times blow with great fury, prostrating houses, fences, and trees.

"The changes in temperature during the fall and winter are frequent and violent, the thermometer varying as much as 40° in 24 hours. During the summer the heat is steady throughout the day, the nights generally being cool, and one enjoys a good night's rest often under winter bedding. The suffering here from heat is more intense than at the same temperature in the Eastern States, owing to the extreme aridity of the atmosphere and the great amount of fine silicious dust that is raised whenever the soil suffers the least disturbance. This dust, besides its extreme tenuity, is very irritating to the mucous membranes, and even the skin, owing to the amount of saline substances it contains.

"As I have remarked, there is an occasional shower during what is considered the dry season. They are much more frequent on the mountains than in the valleys, and are often attended with thunder and lightning. These electrical phenomena, not usual on the Pacific coast, are not continuous and frequent, consisting usually of a few vivid flashes of lightning and heavy peals of thunder, which seem sufficient to restore the electrical equilibrium. Frosts visit the valleys every month during the year, except, perhaps, July and August, and have been known even in these. They do not, however, seem to injure vegetation, unless it be the more tender plants. Nearly every kind of vegetables ripens in these valleys, if planted in season and properly cultivated."

Passing on next to the region of the Great Utah Basin we find that, as a whole, the general amelioration of the Pacific climates is here felt, in the fact of the mean temperature differing little from that of the Atlantic States in the same latitude, notwithstanding its elevation of 4500 to 7000 feet. It is as warm in the annual mean, states Blodgett, from whom we here condense, as the immediate coast of the Pacific. Nevertheless, the sum of conditions in the basin climates is in contrast with that of the Pacific district, as a whole, on several points. The distribution of rain is one of the most important. The succession of rains in spring and early summer is similar to that which prevails in the same latitudes in the Atlantic States. Showers are frequent and irregular, and there is no tendency to periodicity apparent for so much of the year. There is a feature of the rains of the summer at the close of June

worthy of notice. It is the abruptness of the changes of temperature, and the violence of the winds, apparently the incident of the great elevation of the whole plain. The severe changes of temperature during these storms are noticed by Fremont, Stansbury, and Beckwith. The heat and rarefaction of the surface generally render the local atmosphere disproportionately arid over the whole basin region, notwithstanding the frequency of rains at all seasons.

"A very rapid evaporation is in progress apparently at all times, and it can hardly be otherwise, when, even in the early spring, the saline plains glitter with crystallizations—dissolved on one day, perhaps, by the rain, yet formed again almost immediately by its evaporation. Very few of the localities have external drainage, or unite their surplus waters with any stream or lake; and as the rains are frequent at some points, and for some parts of the year, this is," says Blodgett, from whom we here quote, "conclusive evidence that the evaporation is very rapid. The latitude and altitude place much of the country at the border of the *periodical* climates, and where the facts of rain-fall and temperature-range conform to the *equally distributed* division, while the resulting effect upon cultivation conforms to the *periodical* class of climates. At the southern border the tropical features are intruded from the north of Mexico; and the summer rainy season, which gives profuse moisture at a little distance south of the Gila River, is intruded into the Great Basin as a *tendency*, which may attain to profuse rains, or may pass without any."

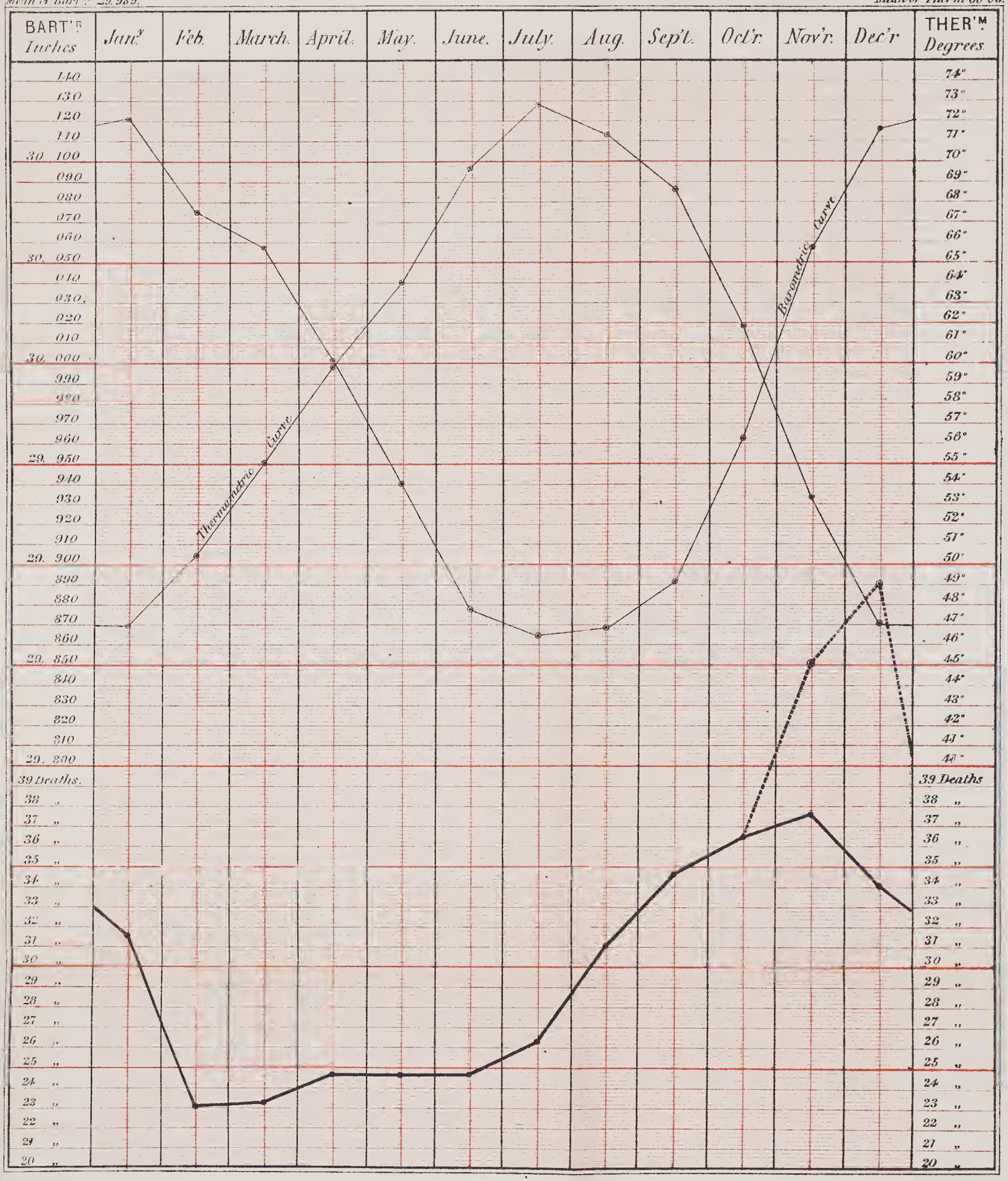
The Colorado Desert is noted for its excessive temperature and absence of rain. But although the summer days are exceedingly hot, and the winters warm, occasional frosts occur in the spring and fall as well as in the winter. Fort Yuma, situated on the west bank of the Colorado, opposite the mouth of the Rio Gila, at the altitude of 120 feet, affords an approximative idea of the climate of this portion of California. If in the valley of the Colorado, which averages seven miles in width, and is bounded by rocky mountains and sand hills on either side, which separate it from the surrounding desert, the heat is so excessive, what must it be in the desert itself? The mean annual amount of rain at this post is only 3.24 inches.

Of the temperature, Surgeon H. R. Wirtz, U. S. A., wrote to the Surgeon-General in June, 1856, that in June and July it frequently reaches 124° Fahrenheit. The latest monthly register for July from the same source reads as follows: Mean for the month

BAROMETRIC AND THERMOMETRIC CURVES FOR NINE YEARS AT SACRAMENTO,

From 1855 to 1864 inclusive.

Mean of Bar'm 29.989. *Mean of Therm 60°05.*



The heavy black Curve exhibits the mean monthly mortality of Sacramento, during 14 years, from 1851 to 1864 inclusive. The interrupted curve shows the effect of the Influenza upon the Mortality, during the three months of its prevalence. 111 deaths by Steamboat explosions are thrown out of the computations. — Mortality 35 per month. Population ranging from 12 to 20.000.

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at 7 A. M., 88°. 80; at 2 P. M., 108°. 12; at 9 P. M., 91°.09. Average daily mean for the month 95°. 36; maximum 116°; minimum 80.° July is usually the hottest month. According to the *U. S. A. Meteorological Register*, December is the coldest month, the mean temperature being 57°.10.

GENERAL RESUME OF CLIMATOLOGY.

One of the elements of climatic topography, which remains to be noticed, is that of the barometric pressure—a force not physiologically appreciable except at great heights. Major R. S. Williamson, of the U. S. Corps of Topographical Engineers, has for some years past been engaged in making observations on the hourly fluctuations of the barometer at the level of the sea and at several points on mountain stations, with the view of determining the exact correction in measuring heights, as well as other questions of great scientific interest. To this gentleman we are indebted for several results of meteorological observations in different regions of the State, which appear in our tables.

The following table, showing the contrasted results of a series of barometric observations made at or near the level of the sea and on the summits of our mountains, will give some idea of the fluctuations of the atmospheric pressure.

Stations.	Altitude.	Length of time obs'd.	Means.	Mean max.	Mean min.	Range.
San Francisco . .	22 ft 0 in.	1856–'63	30.052	30.231	29.900	0.331 in.
Sacramento . . .	54 " 5 "	1856–'64	29.989	30.225	29.722	0.503 "
Aurora	7468 " 0 "	10 mos.	22.990	23.047	22.934	0.113 "
Hope Valley . .	7088 " 0 "	4 "	23.280	23.286	23.275	0.011 "
Strawberry Valley	5710 " 0 "	3 "	24.486	24.500	24.473	0.027 "

The slight variations in the pressure of the atmosphere and the absence of either abrupt or great change, better shown in the following table of successive hourly ranges at Sacramento, give indication of the tropical feature which the climate possesses. The free movement of the aerial mass, if that agency can be supposed to affect this result, is interrupted by the frequent ranges of mountains; or rather, as Blodgett assumes, the accumulated heat and moisture cannot become so great as in corresponding latitudes on the Atlantic coast and elsewhere, where the movements of the mercury are sudden and less restricted, perhaps for want of the volume of lower atmosphere; and therefore the disturbance caused by the

removal of the excess and the restoration of the equilibrium cannot become great and general. The subjoined table, calculated from the horary observations taken once a month by us, at Sacramento, during 1857, gives the mean successive hourly range for the year. The signs + and — denote the range of each hour above or below the mean of 24 hours.

Table of Successive Hourly Ranges of Barometer.

Hours.	Jan. 22d.	Feb. 23d.	Mar. 22d	April 29th.	May 22d	June 22d.	July 21st.	Aug. 25th.	Sept. 23d.	Oct. 21st.	Nov. 27th.	Dec. 23d.	Mean.
7 A. M.	+.044	+.134	—.064	+.098	—.008	+.052	+.028	—.024	+.057	+.080	+.056	+.117	
8 "	+.041	+.125	—.057	+.098	—.016	+.042	+.036	—.024	+.061	+.095	+.044	+.117	
9 "	+.041	+.114	—.032	+.103	—.012	+.038	+.042	—.032	+.075	+.092	+.053	+.122	
10 "	+.036	+.081	—.026	+.101	—.008	+.048	+.044	—.014	+.078	+.084	+.065	+.127	
11 "	+.031	+.058	—.018	+.083	—.010	+.048	+.039	—.002	+.067	+.079	+.038	+.107	
12 M.	+.028	+.028	—.043	+.053	—.010	+.041	+.037	—.017	+.052	+.062	+.025	+.078	
1 P. M.	+.015	+.024	—.049	+.031	—.037	+.018	+.020	—.018	+.031	+.037	+.014	+.047	
2 "	—.029	+.018	—.046	—.010	—.010	+.014	—.008	—.038	+.009	+.008	+.006	+.029	
3 "	—.033	+.012	—.046	—.029	—.052	—.007	—.014	—.038	—.007	.000	+.004	+.004	
4 "	—.053	—.005	—.043	—.047	—.059	—.019	—.012	—.046	—.025	—.024	+.006	—.002	
5 "	—.029	—.005	—.040	—.135	—.056	—.031	—.031	—.050	—.032	—.030	—.003	—.017	
6 "	—.031	—.010	—.008	—.054	—.035	—.019	—.046	—.056	—.032	—.030	+.013	—.021	
7 "	—.028	—.007	—.040	—.060	—.026	—.046	—.038	—.033	—.053	—.018	+.016	—.027	
8 "	—.026	—.006	—.008	—.048	—.024	—.058	—.017	—.018	—.035	—.039	+.002	—.036	
9 "	—.023	—.022	+.015	—.040	+.002	—.037	—.010	—.005	—.024	—.036	+.004	+.037	
10 "	—.047	—.022	+.040	—.019	+.040	—.027	—.010	+.030	—.022	—.045	—.005	—.039	
11 "	+.002	—.042	+.046	—.011	+.043	—.016	—.007	+.023	—.019	—.038	—.005	—.042	
12 "	+.022	—.042	+.052	—.030	+.045	+.012	—.009	+.026	—.021	—.032	—.009	—.051	
1 A. M.	+.005	—.051	+.057	—.027	+.048	+.015	—.012	+.028	—.016	—.030	—.019	—.064	
2 "	+.005	—.053	—.064	—.025	+.051	+.007	—.013	+.031	—.013	—.034	—.032	—.066	
3 "	+.010	—.062	+.067	—.022	+.053	—.005	—.013	+.030	—.020	—.040	—.046	—.074	
4 "	+.013	—.083	+.072	—.019	+.051	—.012	—.011	+.065	—.033	—.035	—.066	—.071	
5 "	+.015	—.087	+.072	—.019	+.043	—.024	—.019	+.086	—.045	—.052	—.086	—.091	
6 "	+.013	—.097	+.073	—.022	+.034	—.028	.000	+.108	—.026	—.046	—.086	—.106	
Sums	600	1186	1078	1084	833	664	516	842	853	1066	703	1495	
Means	.025	.049	.045	.045	.035	.028	.022	.035	.030	.044	.029	.062	.038

The mean successive daily range frequently in summer does not amount to more than the $\frac{94}{1000}$ part of an inch. The mean difference of the successive months, above or below the annual average, is not more than $\frac{1}{11}$ of an inch. Between the highest mensual mean, and the lowest, a fraction over $\frac{1}{4}$ of an inch is found. The extreme ranges observed during the month are also limited. In the barometric curve the evidence of some regular moving influence is plainly revealed in the annual tide—gradually descending as the sun approaches the northern tropic, and ascending as it returns towards the southern. The extreme annual ranges are also small. In some of our former publications we stated a minimum, which was observed in December, 1853, of 28.980 inches—giving a difference from the maximum of the same year of 1.460 inch. This, however, may be attributable to a defective instrument, as we have never since made so low a reading. A more reliable, and the next lowest minimum was 29.380 inches, observed with Gay

Lussac's siphon barometer, on the morning of the 1st of January, 1855, during a strong gale from the southeast. The greatest mensual range was also observed in the same month—the maximum for the year having reached 30.410 inches in the same month, and giving a difference of 1.030 inch for the month as well as for the year. These instances of extreme range we regard as exceptional, and therefore they do not enter into our computations, which commence from January, 1856, the date of our first using the Smithsonian barometer. Since this time the highest reading was on the 19th of December, 1856, viz., 30.619, and the lowest on the 26th of January, 1865, viz., 29.497; the extreme range, therefore, is 1.122 inch. During the rainy season, northerly winds always determine the greatest elevation, and southerly, the greatest depression of the mercurial column. This rule is not so constant during the dry season.

In review of the distinctions of a general character belonging to the climate of the different regions of California just discussed, they may be briefly summed up, in the words of Blodgett, as being, "*Aridity* first; *isolation* of districts and conditions next; and thirdly, *periodicity* of rains, winds, and some other prevailing phenomena, in distinction from equally *distributed* rains, etc., as in the Eastern States. The *isolation* of phenomena implies an interruption of the symmetry so characteristic of the East, and all the important differences which follow in this train. Extreme contrasts, diversities, and transitions belong here to place or locality, and in the East to *time*."

The leading distinction of aridity is clearly shown in the table by the rain-distribution, and though there are exceptions to the rule that atmospheric humidity is fairly indicated by the quantity of rain, they do not apply to any point here except the immediate coast of California. There the low peculiar summer temperature is almost constantly attended by fogs and mists, but there is no parallel to this phenomenon in the interior, or beyond a very narrow line of coast. In the mountainous districts the illustration is, on the other hand, in excess of a fair representation of the humidity, as the rains are local and profuse while falling, occupying little time or space, and succeeded at once by the otherwise constant aridity of the air.

Excepting temperature, there are, perhaps, no conditions of the air more important to be studied, in a medical point of view, than those dependent on the presence of aqueous vapor. It is the ab-

sence of what has been supposed to be a prolific source of pestilence, viz., a high dew point with a high temperature, that constitutes the hygienic element of the Pacific climates—so far as the present state of science warrants such conclusion; and as a knowledge of the causes of this dryness of the atmosphere, especially during the summer months (see table of Relative Humidity), is essential to a proper conception of its medical constitution, we here present the following philosophical and simple account of the distribution of moisture in California, from the U. S. Agricultural Report for 1862. It is necessary to premise that, during the winter, when it rains, the winds invariably blow from the south, and southeast; and when it is dry, from the north and northwest. In the summer the former are the moist refreshing equalizers of the climate, while the latter, which are highly charged with positive electricity, are hot, dry, and blighting to vegetable as well as animal life. The northwest wind is dry, because in passing from the equator to the pole it has parted with all the moisture it had absorbed, when rising into the upper regions of the atmosphere at the equator.

During the season of 1863–4, which was one of drought in California, the northwest winds were always greatly in excess of the average. Why it was so, meteorology cannot at present furnish a satisfactory explanation; but why the winds of the wet season in California are from the southeast instead of from the southwest, as in the eastern part of the continent, conformably with the following theory, is easily explained. East winds are mere surface winds, caused by an approaching fall of rain and snow, or condensation. They prevail in the east as well as here in the winter. But the rain comes from the higher strata of clouds, which are moving from the S. W. to the N. W. Now we have seen that our mountain ranges run from the S. E. to the N. W.; these deflect the S. W. winds from their natural direction towards the N. W., or from the S. E. Hence, the eastern winds, caused by rains, would naturally unite with the deflected S. W. winds, and aid their deflection.

With this understanding of the subject, we conclude with the following statement, just referred to, respecting the machinery employed by nature for the distribution of moisture in California:—

Force of Vapor. Monthly and Annual Means for Eight Years at Sacramento.

Y'rs.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct	Nov.	Dec.	Means
	inches	inches	inches	inches	inches	inches	inches	inches	inches	inches	inches	inches	inches
1857	.295	.297	.347	.421	.427	.500	.474	.454	.415	.352	.286	.253	.377
1858	.238	.303	.301	.344	.366	.413	.433	.456	.401	.328	.306	.222	.343
1859	.231	.289	.257	.321	.363	.503	.469	.451	.410	.367	.347	.230	.353
1860	.262	.258	.316	.342	.358	.421	.476	.478	.411	.372	.266	.283	.354
1861	.257	.307	.340	.382	.397	.434	.501	.457	.464	.330	.312	.322	.375
1862	.278	.273	.298	.286	.333	.436	.485	.451	.412	.391	.270	.221	.345
1863	.248	.248	.305	.340	.387	.400	.480	.434	.441	.312	.234	.258	.338
1864	.275	.282	.298	.353	.397	.406	.403	.440	.392	.336	.264	.315	.347
Sums	2.084	2.257	2.462	2.789	3.028	3.513	3.721	3.621	3.346	2.788	2.285	2.104	2.832
Means	.260	.282	.308	.348	.378	.447	.465	.452	.418	.348	.285	.263	.354

Relative Humidity. Monthly and Annual Means for Eight Years at Sacramento.

Years.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept	Oct.	Nov.	Dec.	Means
	per ct	per ct	per ct.	per ct.	per ct	per ct	per ct	per ct.	per ct.	per ct	per ct.	per ct	per ct.
1857	85.24	78 07	75.68	74.92	70.22	64 14	60 62	63 79	58.68	67.84	72 21	79 88	70.10
1858	79.57	76 52	72 95	67 30	61.48	59 57	60 05	62 81	59 01	65 18	73.58	74 98	67.75
1859	78.05	78.73	68 32	68.90	64.81	59 51	66.95	68.68	65 61	64 41	82 32	80 30	70 55
1860	82 86	72 10	76 90	71 97	72 65	67.13	64 00	58.89	61 91	72 76	65.34	78 89	70 45
1861	78 37	77.93	75 30	72 03	67 47	67 40	60.94	63 35	68.68	64.27	74.67	85 00	71 28
1862	84.32	81.57	72 22	59.47	62.55	59.30	53 50	53 33	55.83	62.11	63 00	70 03	64.77
1863	75 69	72.68	67.24	66.18	58.08	55.74	54 52	58.33	60 33	56.00	60.05	77 03	63.65
1864	78 26	68 69	64.68	60.50	58 67	54.60	49.75	52.18	55.96	57.25	84.73	84 87	64 18
Sums.	642 36	606 29	573.29	541.27	515.83	487.39	470.33	481 36	486 01	509 82	575.90	630 98	542.57
Means.	80.29	75.79	71.66	67.66	64.48	60.92	58.79	60.17	60.75	63.73	71.98	77.62	67.82

"On each side of the equator, when the sun is vertically above it, and reaching to about the fifteenth degree of latitude on each side of it, and moving with the sun as it travels north and south of the equator, is a belt of dry surface winds encircling the earth, and blowing with a uniform and gentle force into the equator The wind of the north belt blows from the northeast; that of the south belt from the southeast. As these surface winds approach each other they rise, being expanded by the intense heat of the vertical sun, and become upper currents. The surface or lower currents are called the trade-winds; the upper, the counter trade. Mr. Maury and Mr. Butler maintain that the south belt of trade-wind, when it rises, becomes the northern counter trade or upper current, and the north belt of trade wind becomes the southern upper counter trade. These currents pass through each other in strata, which may be represented by passing the fingers of the

hands between each other. But the generally received opinion is, that these surface currents strike against each other as they ascend, and turn each other back over the hemispheres from which they came. I regard the first opinion as more philosophical, because currents of air more readily stratify than repel each other; and because the southern hemisphere of the earth is chiefly water, the immense evaporations of which are more needed to water the land hemisphere of the north than to be discharged on the ocean, where they are not needed. 'Nothing has been formed without a purpose.'

"Between the points from which these opposing surface belts of wind begin to rise there is a belt of rains also encircling the earth, and about five hundred miles wide. It is called the rainy belt, and from it pour down those torrents of rain which fall on Central America.

"As these dry surface trade-winds pass over the land and the ocean they absorb immense quantities of moisture, and their capacity to hold it is increased by the great heat imparted to them from the rays of the vertical sun. After they have risen, and become the upper or counter trade, the north one passes, at first, in a northern direction; but on account of the diurnal rotation of the earth it is gradually turned to the east, forming the southwest wind, so general during summer in the Atlantic States. As it passes northwards into a colder atmosphere it loses its heat; the moisture, in consequence, condenses, and at about fifteen degrees north of the equator, portions of the wind and moisture descend to the earth. Other portions having received the latent heat, liberated from the moisture that has descended as rain, continue northwards even to the north pole. The portions of the earth receiving these rains are called the extra-tropical rainy regions.

"The central rainy belt and these two belts of dry trade-winds follow the sun in its passage north of the equator to the tropic of Cancer, nearly to the twenty-fourth degree of latitude. As the northern edge of the dry trade-winds reaches fifteen degrees north of the latitude of the sun, when the latter is at the tropic of Cancer, this northern edge reaches to about the thirty-ninth degree of latitude, being within three degrees of the northern boundary line of California. But, before the sun reaches the tropic of Cancer, and after it begins to recede from it, northern California receives the rains that fall beyond the dry trade-winds. Thus, this part of the

State receives more rain than the southern portion, which is longer covered by the trade-winds."

Besides the periodicity of the winds and rains, the limited oscillations of the barometer, and the general small range of the thermometer, there is still another indication of the tropical features of the climate of California to be noticed in the clear and cloudless sky. In a series of twelve years' observations at Sacramento, we find that, on an average, there are 197⅓ days in the year in which no clouds whatever are visible. The sky, during the greater part of this period, presents the deep blue of that of Italy, and so transparent is the atmosphere, that the summits of the Sierra Nevada range can be seen at Sacramento, a distance of 100 to 150 miles, as distinctly as if they were only a mile or two distant. This atmospheric characteristic does not always obtain, however, at least in the valley. During some of the hottest, and, as far as the lower strata of air are concerned, dryest days of the summer months, there is observable a vapory condition of the atmosphere, obscuring to a considerable degree the natural color of the heavens. This condition is much less frequently observed when the wind is blowing fresh, especially from the northwest. These facts, however, as has just been stated, can only be regarded in the light merely of *indications* of the tropical tendency of the climate; for, in the aggregate of its constituents, it has more of a temperate than a tropical character. This conclusion, to which we have arrived from the simple interpretation of figures and meteorological details, is fully confirmed from what has been observed respecting the physical influence of the climate, its effects upon the physical system of its inhabitants, considered in a distinct aspect from its morbific tendency.

Every one who remembers the gayness and lightness of spirit which a bright, sunny day produces after a period of cloudiness, is prepared to admit that light must exercise an important influence on the functions of the animal economy. Had we no other reason we should be authorized in inferring that that, which is so potent on vegetable life, stimulating the flower to expand its petals and welcome the vivifying agency with its fragrant embrace, is, also, though perhaps more obscurely, a stimulus to man. The physiology of the two kingdoms has always been found to be more or less closely related; and in the relations referred to, especially, proofs are not wanting. Deprive the tadpole of the influence of

light and nourish it as we will, it remains a tadpole still.[1] Further development is arrested. So if we attempt to rear the tender human plant in well-curtained drawing-rooms, or ill-lighted and ill-ventilated manufactories or school-houses, instead of the development of healthy, we have that of tuberculous and other heterologous growths.

It may be a question, if, in California, the excess, or rather the long continuance of clear, sunshiny days does not act too potently as a stimulus, intensifying all the vital actions to a degree of exaltation often ending in collapse. With the *corpore sano*, the *mens sana* is certainly not always associated, as the crowded condition of our lunatic asylum unfortunately attests. Nevertheless, we incline to the opinion that this result of super-excitation is not so much to be attributed to the cheering sunshine and invigorating climate, as to man's abuse of his limited powers, and to that restless spirit of aggrandizement which is permitted to spread its dark and noisome cloud over the bright mental atmosphere which always attends the bright physical one.

With nothing to bias our minds in this view of the subject, the register of observations, as we have just stated, being our climatological bearing, we are pleased to add that we are fully sustained by a competent observer, Dr. F. W. Hatch, whose remarks in this connection we here quote from the *New York Journal of Medicine*, for July, 1855:—

"We shall not stop to discuss the question of the influence of the climate upon the development of man, as an organized being, though there are many substantial reasons, drawn alike from analogy and from direct and positive demonstrations, upon which the proposition of its superiority, in this respect, may be successfully maintained. Indeed, it may be remarked, that nowhere is there exhibited in the physical development of the animal organizations of a country, a more conclusive evidence of the directly modifying tendency of its climate, than is displayed among some of the animal races in California. The vigor, the energy, the physical amelioration which ensue upon their introduction into the State, can only be referred to this agency, and their thorough appreciation must lead, with all the weight of a sound analogy, to the substantiation of the principle to which we allude. The view of the climate which we intended, more especially, to illustrate, is

[1] Milne Edwards in Ward on Close Cases, p. 112.

that of the resilieney, the elasticity it imparts to the system under the inroads of severe disease, or the shoek of local violenee—the reeuperative energy displayed under eireumstanees the most inauspicious and discouraging. During a residence of nearly four years, numerous instanees, illustrative of this climatic tendeney, have oeeurred, and we regard it as one of the most remarkable, felicitous, and interesting expressions by whieh it is distinguished. Allusion has already been made to the remarkable exemption from disease exhibited by our inhabitants, under eireumstanees which, by all the proeesses of reasoning commonly adopted, would be expeeted to lead to a different result. In the earlier days of the settlement of the State, these modified influences were much more prevalent than at the present time; but, even now, they are to be seen every day, and serve as living evidences of the exeellenee of the elimate—of the existenee of the peculiar element of health under consideration. If we take, for example, the eondition of some portions of this valley during the summer months, steaming beneath the rays of a burning sun, diffusing the rank vapors which arise from the depositions of an inundation over vast neighborhoods, or, as shown on a previous oeeasion, even of this eity in the days of the annual floods, and observe the transient, the trifling, the very equivoeal evils which ensue, we are at once furnished with a satisfactory illustration of the elimatie prineiple to which we refer. But even more clearly is this principle displayed in the recuperative energy of the system under the destructive influences of disease or violeuee. No better evidenee of this ean be required than what may be fairly dedueed from the following case:—

"A gentleman, of a naturally strong and vigorous constitution, was severely injured in a recent steamboat explosion at this port. Besides a large number of burns or sealds, denuding the cuticle from an extent of surfaee not less, in the aggregate, than five hundred square inehes, upon his right leg was a eompound comminuted fraeture of both bones. The eomminution was for an extent of about five or six inches of the tibia, and in some ten or twelve pieces. The protrusion of the bones was in two plaees, one each at the upper and lower extremities of the fraeture. In faet, the tibia was completely crushed for the extent mentioned. In addition to the exfoliation of the eutiele by the sealds, the eutis vera and eireumjaeent eellular struetures were entirely destroyed over a space not less than twelve or fifteeu square inehes. When the patient was fouud, after the accident, sueh was the vital depression,

such the destruction of tissues around the fractured extremity, such the extent of nervous filaments exposed through the bare and denuded cutis, such the gloom, the mental depression, attending an accident so frightfully fatal in its consequences, that all reasonable probability militated against the saving the limb. If to these untoward prospects we add the profuse drain which was so soon to be established from so extensive a suppurating surface as that which the scalds had exposed, and the debilitation which must inevitably ensue, it must be admitted that the prognosis of an ultimate recovery with the integrity of the limb preserved, was scarcely to be entertained. Surgery—the science, the theory of surgery—here would have taught that amputation was almost inevitable. But an operation, postponed in deference to the wishes of the patient, at length became unneeded. Nature, taking the case into her own hands, almost unaided, save by the influence of the inherent efficacy, the recuperating impulse of a favorable climate, is repairing the injury in her own quiet way, and triumphs over the precepts of science and the sagacity of the surgeon.

"This is no isolated case. Its counterpart may frequently be met with in medical and surgical practice. Akin to the principle of organic development, of which we have already spoken, this constitutional element of the climate is equally pervasive, and is strongly exemplified by the most unmistakable evidences."

In order to afford a succinct and precise idea of the prominent features of the climate of California, the accompanying tables and curves have been prepared. The important points under consideration are thus reduced, in keeping with the spirit of the age, to quantitative description as far as the nature of the case admitted. Through this means, rather than by tedious commentary, we are the better enabled to demonstrate at a glance, intensities, amounts, and results, with an infinite saving of time, and, what is far more desirable, with numerical precision and truth. The tabulated series of thermometric monthly means, with the variations therefrom, at the hours of the three daily observations, give with their graphic representative the range of the temperature during the seasons of the year, and when viewed connectedly show the difference of the climate of the places whence they are derived. They also show the variations of the hour of the day. As observations at 2 P. M. give nearly the greatest temperature at that time during the month, and as the mean of the 7 A. M., 2 P. M., and 9 P. M. observations gives nearly the mean of the month, so when it is shown that the

mean at 2 P. M. in a month, or a series of months, is + 5° 7′, it expresses the fact that the thermometer during twenty four hours has a range of 5° 7′ above and below the mean. Many other facts of value may be gathered from these tables by those familiar with meteorological studies. In the comparative table the results of the annual and monthly averages of temperature for the whole period observed, together with the range derived from the mean maxima and mean minima, which are given, exhibit the difference of the temperature of the regions already passed under review. To facilitate the comparative estimate, the latitude, longitude, altitude, and mean annual amount of rain are also inserted. These contrasted summaries show how irregularly the isothermal localities in the State are distributed, and also how widely some of the districts we have grouped together are thermally separated from each other. It is also seen that while there are but few places in which the precipitation of aqueous vapor is approximately the same, there are many in which the difference is remarkably striking. These anomalies of temperature and rain distribution, while putting to fault the general law, that in temperate latitudes the atmospheric temperature is reduced one degree for every 333 feet of elevation above the sea, and that the quantity of rain diminishes in advancing from the equator to the poles, can by no means be construed into any manifestation of uniformity or correspondence between the ranges of temperature and quantities of rain at different elevations.

It must, however, after all, be conceded that apart from their scientific relations, it is very questionable whether the results arrived at have any direct value for medical purposes. To serve the ends of hygiene and the elucidation of the etiology of diseases, contemplated by reports like the present, every city, village, and settlement should have its meteorological record. We have endeavored to supply the deficiency by our general climatological description of the various regions passed under review; but, as has been made apparent, no two places, however inconsiderably distant, in a topographical point of view, even in the grouping we have employed, are to be found possessing the same mean temperature, not to speak of all the other meteorological phenomena that go to make up what is meant by climate.

It only remains for us now to hope that what we have accomplished may serve for a ground-plot, on which to raise a superstructure that will cover such a knowledge of topographical and meteorological conditions as shall disclose the true and intimate relations of health and disease to locality and climate.

Comparative Table of Meteorological Stations in California.

Stations.	Altitude above the Sea, in Feet.	Latitude.	Longitude.	Length of Period Observed.	Temperature.				Rain and Snow in Inches.	Authority and Remarks.
					Hottest Mean Day.	Coldest Mean Day.	Range.	Mean.		
Fort Yuma	120	32° 43′	114° 36′	6 years.	92	56	36	74.00	3.24	Army Met. Register, 5 years partially.
San Diego	150	32° 42′	117° 14′	7 "	74	52	22	62.00	10.43	" " 3 " "
Monterey	140	36° 36′	121° 52′	6 "	59	50	09	55.00	12.20	" " 4 " "
Fort Miller	402	37° 00′	119° 40′	5 "	90	47	43	66.00	24.51	" " 4 " "
San Francisco	22	37° 48′	122° 27′	9 "	78	39	39	55.90	22.09	Williamson and W O. Ayres, M. D.
Benicia	183	38° 08′	120° 14′	8 "	80	44	36	59.12	22.86	W. W. Hays, Surgeon U. S. A.
Stockton	35	37° 37′	121° 14′	4 "	72	56	16	62.00	15.10	R. K. Reid, Physioian Lunatic Asylum.
Sacramento	54	38° 31′	121° 29′	12 "	94	32	62	60.06	18.23	Thomas M. Logan, M. D.
Marysville	76	39° 12′	121° 42′	1 "	90	38	52	63.32		W. C. Belcher, 1858.
Fort Reading	674	40° 31′	122° 05′	4 "	83	44	39	62.09	29.02	Army Met. Register, 2 years partially.
Aurora	7468	38° 19′	119° 00′	1 "	82	20	62	52.00		Major R. S. Williamson, U. S. A.
Hope Valley	7088	38° 47′	119° 54′	4 mos	61	11	40	40.00		" " " "
Strawberry Valley	5710	38° 49′	120° 07′	3 "	69	24	35	51.00		" " "
Fort Jones	2570	41° 36′	122° 52′	3 years.	71	31	40	51.40	16.77	Army Met. Register, 2 years partially.
Astoria	50	46° 11′	123° 48′	18 mos.	62	39	23	50.20	86.35	Blodget and Williamson, Jan. '59 to Dec. '60.
Fort Oxford	50	42° 44′	124° 29′	4 years.	61	46	15	53.62	71.63	Army Met. Register, partially.
Red Dog, Nevada Co.	2900	39° 13′	120° 47′	3 "					64.00	W. A. Begole, 1862, '3, '4.
Nevada	2630	39° 18′	120° 52′	1 "	72	45	27	55.75		John McCoy, County Assessor.

EPIDEMICS.

The remainder of this report, comprising ninety-two pages of manuscript, is devoted to the consideration of Epidemics. The reporter arranges the diseases alluded to into three classes, namely, *Contagious* Epidemics, as Variola, Scarlatina, and Rubeola; *Infectious*, as Typhoid, Typhus, and Spotted Fevers; and *Meteorations*, as Influenza and Diphtheria. The first nine pages are written by Dr. Logan, and relate chiefly to the prevalence of variola.

It is stated that wherever this disease has made its appearance among the Indian tribes, the native Mexicans, or the mixed races, whether of Mexico or California, it has generally proved exceedingly fatal. On the other hand, the Chinese in the latter State seem to manifest but little susceptibility to the disease. Among the American part of the population the disease has exhibited no phenomena or tendencies different from what have been observed in the Atlantic States. The only account given of its prevalence to such a degree as to merit the title of an epidemic, was in the winter and spring of 1861 and '62. During the first six months of 1862, there occurred in Sacramento about 270 cases, of whom 12 died. More than one-third of the whole number of cases were *varioloid*. Prompt vaccination and revaccination were found as efficient in limiting the spread of the disease, in that locality, as they have been elsewhere. The reporter gives nothing new in relation either to the pathology or the treatment of the disease.

Scarlet Fever and Measles.—The next twenty-four pages of the report are devoted to a consideration of the prevalence of scarlatina and rubeola, by F. W. Hatch, M. D., of Sacramento. Concerning the prevalence of scarlatina in that locality, Dr. Hatch writes: "Its first appearance seems to have been in 1856, commencing in July and continuing through December; the total mortality being only five. In April of the following year, and again in November, one death for each month was reported. From this time no traces of its fatal presence appear to have been seen until 1860. During this year its epidemic character was well marked from January until the close of the year, the highest monthly mortality being in May, June, and December; and the total deaths for the year, forty-eight. Admitting the population of the city to have been 14,000, we have one death in every 292 inhabitants, or 3.4 nearly in 1000. The entire mortality by all causes having been, in 1860, 425, excluding still births, we find the pro-

portion by scarlatina alone to have been about eleven per cent. The next that was seen of it seems to have been in November, 1861, and from this date to February, 1862, with a total mortality of eight. In December, 1862, it reappeared, to terminate in January, 1863, with the very moderate record of only four deaths. In December of 1863, the disease seems to have assumed once more the similitude of an epidemic, raging more or less violently through the entire year following, and, as the records for January, 1865, show, even into that year; the total mortality from its commencement in December, 1863, to the close of January, 1865, having been twenty-seven, or about 0.19 in each 100 of population."

The report states that, during the same years here mentioned, this disease prevailed in many of the smaller towns in the Sacramento valley, and as far distant as the foot-hills of the Sierra Nevada. But no reliable statistics could be obtained relative thereto. From very imperfect records kept at San Francisco, it appears that both scarlet fever and measles prevailed in that city to a moderate extent in the years 1858, 1859, 1860, and 1863. Dr. Hatch states that throughout the Sacramento valley, in San Francisco, and in Oregon, in the years above named, the prevalence of scarlatina and measles was intimately associated with that of diphtheria; and that all these diseases prevailed most during the rainy or transition seasons of the years. Sufficient connection between the meteorological phenomena and the prevalence of these diseases is not shown to throw any additional light on the question of etiology. Neither does the report afford any new facts concerning their pathology and treatment.

METEORATIOUS EPIDEMICS.

Under this head is included another paper by Dr. Hatch, occupying thirty-eight pages of manuscript, on the subject of diphtheria. Of this disease, the first case was reported at Sacramento in 1854, from which time it continued to prevail to a very moderate extent up to the commencement of the present year. The total number of deaths attributed to the disease during the eleven years was 131, of which 41 occurred in 1860. The writer regards croup, when epidemic, and diphtheria as identical, and, to a limited degree, as contagious. The disease, as it prevailed in California, and described by Dr. Hatch, appears to have presented no features different from the descriptions found in all our medical works. Neither

does his paper present any new or additional facts in regard to its causes, pathology, or treatment.

The remaining twenty pages of the report are written by Dr. Logan, and as they are, in some measure, corrective of opinions advanced in a previous report printed in the *Transactions* of this Association, it is deemed best to retain them in full.

N. S. DAVIS,
In behalf of Section on Meteorology, Epidemics, &c.

INFECTIOUS EPIDEMICS.

In accordance with the arrangement we have adopted, it would be in order to treat, under this head, of those zymotic or febrile diseases which, while their primitive cause is supposed to consist in malaria, are assumed to possess the property of propagating their like, by means of a vitiated or poisoned atmosphere emanating from and surrounding the diseased person, without contact of the body or clothing.

Of this class of diseases we have no special epidemic to report from California proper. This State, considered by itself, has been comparatively exempt, since our last report, from the prevalent forms of those febrile endemics peculiar to certain localities, the geological formation of which would seem to favor their production, and which sometimes become epidemic.

It must not be inferred from this statement, however, that either before or since the wide-spread epidemic of autumnal fever in 1858, we have enjoyed a perfect immunity from such disorders, or that the periodical diseases, *always* more or less prevalent during our fall and winter seasons, are confined to regions where the concurrence of all the conditions supposed to be necessary for the production of malaria are found to exist. Such a conclusion would not only be at variance with fact in the first instance, but would lead erroneously, in the second place, to an apparent confirmation of the generally recognized hypothesis respecting the origination of malarial fevers.

Not only "in the neighborhood of exposed river courses and low places," as stated in our last report, have these endemics been encountered every season as usual, but, as our professional acquaintance has been extended by the increased travel into the mountainous parts of the Pacific States, the same forms of disease have been found occurring in localities where it might be rationally inferred

they would be least likely to present themselves. It is true they have always appeared in such localities, more or less modified, as will be seen hereafter—varying from the true type in so many particulars as to favor the idea of original disease. But that they are attributable to the same origin we think is clearly evident, although, unless we resort to the much disputed calculations upon the distance to which malaria may be conveyed, the ultimate cause, notwithstanding what we formerly advanced, remains involved in greater obscurity than ever.

Our purpose in describing, in the former report, the origin and progress of the epidemic visitation of autumnal fever in 1858, as far as observations and inquiries enable us to trace it, was to place on record the additional evidence, drawn from the comparatively *terra incognita* of California, respecting the supposed laws or conditions controlling the same — believing that if ever we are to arrive at a full and accurate knowledge of these essential circumstances, it will be by the combinations of such faithfully reported histories of all the phenomena, cosmical, meteorological, topographical, etc., associated with the origin of the disease, and a patient analysis of their details.

The irruption of that epidemic coincidently with the introduction of an extensive system of irrigation, by means of reservoirs and canals, was well calculated to lead to the inference, in this instance, of cause and effect, and to sustain the hypothesis of the conjunction of heat, moisture, and vegetable decomposition as essential to its production. That these conclusions, although at the time thought to be legitimate, are not wholly tenable, subsequent experience has fully demonstrated. For while fevers of an intermittent and even of a remittent type have occurred under the same concurrent conditions, still they have by no means, since then, invariably manifested themselves in a uniform degree or intensity, and never in the epidemic form, which should have been the case if the above-mentioned hypothesis was sustained by fact.

During the six years subsequent to 1858, we have experienced one season of excessive rain, one of great drought, and four seasons of average weather, while the condition of the valley-region with regard to canals, ditches, and reservoirs has remained the same. Notwithstanding this variation, there has been no sharply defined deviation from the average number of cases of fever in any one of these five seasons.

By reference to our tables, it will be perceived that during the

three years subsequent to 1858, as shown in the percentage of saturation, the relative humidity was actually greater in the months of July, August, September, and October of the following years, than it was during the season of the epidemic; while, at the same time, the temperature, in like manner, was also in excess in the subsequent years. It is evident, therefore, that the combination of these elements in the low valley-region did not constitute the malarial agent. The vapor existing in the atmosphere in an independent state may possibly be more concerned in the agency, but in what mode and to what degree, it is beyond the power of science to determine. It will be observed, by referring to the proper table, that the separate force or pressure of the vapor was decidedly less during the season of the epidemic than in either the preceding or the three following seasons.

To what, then, are we to attribute the origin of these fevers, and to what, the epidemic form assumed in 1858? It was at first supposed by us that, as these fevers always manifested themselves more or less in the low alluvial bottom lands of the valleys, rather than upon the primitive formations, geological structure favored their development; but, as has just been stated, they have been found alike, though not as frequently it is true, among our snow-capped sierras, as in less elevated regions. In our utter inability to meet these questions, it may be replied that the poison of the fever might have remained in the system, and become subsequently developed weeks and months afterwards. Or, again, although we do not believe in the doctrine of acclimation in the broadest acceptation of the term, except in yellow fever, which we recognize as a disease *sui generis*—self-protecting, like smallpox—still, inasmuch as we find the insusceptibility of negroes and of those of mixed blood, born and bred in hot climates, amounts almost to immunity; and inasmuch as, likewise, for the first year or two, natives of the colder climates generally possess the power of resistance to malarial influence, may we not attribute the comparative exemption of our population, during the late year from fevers, especially of the epidemic character, to some peculiar modifying, invigorating property of the climate, productive of tolerance to the poison? We have already pointed out the remarkable escape of the Chinese portion of our population from the smallpox epidemic. May not similar causes, which produce this result, have been operative also with regard to other diseases in the other races? Not that it is to be inferred that the Chinese are to be excluded in the present case. On the

contrary, while this peculiar people seem to possess a special proclivity to all forms of enteric disease, typhoid pneumonia, and scrofulous affections, it is but seldom that we are called upon to treat them for the more inflammatory forms of malarial fevers. And in this connection we here take occasion to state that our own convictions, after a long residence in Charleston and New Orleans, are that the susceptibility of the different races of mankind to all malarial fevers appears to be in a direct ratio to the whiteness of the skin. And although we are willing to believe, with Dr. I. C. Nott, that climate does not make the race, but that the race was originally made to suit the climate in which nature placed it; still there must be something more than race in effecting this comparative immunity, inasmuch as the insusceptible dark-skinned races are for the most part natives of warm climates and are acclimated at least to temperature. Witness the Iberian part of the population of Europe—also the Malays, Mongols, Negroes, etc.; are they not all originally natives of warm climates?

Leaving, however, the intricate problem of climatic influences in regard to susceptibility to disease, we turn to the more practical part of our subject, and proceed to describe the modifications of malarial fevers in the elevated regions passed under our topographical review.

Mountain Fever.—Under this designation is described by Dr. Ewing, in the *St. Louis Medical and Surgical Journal* for March, 1855, a disease which he considers *sui generis*, appearing only at an altitude of about 7000 feet, and dependent upon the respiration of rarefied air in some mysterious way not explicable; inasmuch as, he thinks, the elevated situation at which the fever occurs precludes the idea of the agency of malaria in its production. This description, states Dr. Robert Bartholow, U. S. A., in his interesting report to the Surgeon General, corresponds to some of the cases which he happened to meet at Fort Bridger, Utah Territory. The latter writer believes that there are two types of the affection —the periodical and the continued—and that these are often so modified by certain local conditions as to be readily confounded, and to present so many variations from the true type as to be considered an original disease. Dr. Bartholow's views coincide so nearly with our experience in cases of this form of disease among travellers returning from Nevada Territory, that we cannot do better than adopt his description entire: "All cases were ushered in by a chill, more or less decided, which lasted a variable period.

In the febrile stage the pulse was full, quick, frequent but soft, and sometimes dicrotic; the skin hot, dry, and mordicant; the tongue heavily furred in the centre, red and dry at the edges and tip. There were present also intense cephalalgia; aching in the back and limbs; suffusion of the eyes; loathing of food, and sometimes nausea and vomiting. Delirium occurred in several cases during the exacerbations. The remissions were characterized by debility, listlessness, and indisposition to the slightest exertion of body or mind, and a most painful aching of the limbs. The countenance at these periods was vacant, dull, and tinged a dirty-yellow; the pulse small, quick, irritable; the skin moist, perspiring, but sweating was never profuse. Diarrhœa was a frequent symptom: the stools were thin, yellowish, watery, and offensive—occasionally greenish, dark-brown, or black. The urine was occasionally scanty, and deposited an abundant lateritious sediment. The chill was not regular in duration, nor did it usually amount to a distinct rigor, and the febrile reaction was extremely gradual in its approach. In some instances the two stages were coincident, and during the highest excitement a sense of chilliness was experienced. The appearance of the tongue was peculiar—heavily loaded with whitish fur, through which enlarged papillæ protruded: like the 'strawberry tongue' of scarlatina. The most painful, as well as persistent, symptom was the aching of the back and limbs. Having suffered an attack *in propriâ personâ*, I can testify to the acuteness of these pains. By some officers of the army, who had some experience with the pains of dengue, it was likened to that affection, and bore amongst them the name of 'break bone fever.' There was little regularity in the paroxysms, either in duration or periods of recurrence.

"Two classes of cases occurred, differing only in intensity: the *mild* and the *grave*. The former, if left to the unassisted efforts of nature, after a variable duration, gradually ceased, but manifested a disposition to relapse at uncertain intervals; the latter, however, tended to the continued type, if not arrested by quinia, and was not easily distinguished from the typhoid cases, which, during the early stages, were unequivocally remittent. This is a fact with regard to the behavior of typhoid fever at considerable elevations, heretofore observed—the occurrence of distinct remissions, and it is this circumstance which, in my opinion, has confused the deferential diagnosis of the two affections, creating the impression that they were forms of the same disease—'mountain fever.' The typhoid fever of Utah has other peculiarities beside the occurrence of remissions. Many of those general symptoms, so characteristic,

were wanting: coma, subsultus tendinum, muttering delirium, floccitatio; but in all were present some mental disturbance and stupor, cophosis, epistaxis, gurgling on pressure over the ileo-cæcal valve, pea green, watery stools; in two instances the 'rose spots,' and frequently the sudamina and sour-smelling perspirations. All the fatal cases were submitted to a post-mortem examination, and the characteristic lesions of typhoid fever invariably found. Holding these views of the nature of the so-called mountain fever, and having treated it successfully by the abortive method—the heroic administration of quinia—it remains for me to account for its origin. I do not hesitate to declare my conviction that the periodical form of mountain fever is a disease of malarial origin, modified by elevation and rarefied air. The cases which occurred in the army of Utah, happened in those men who had served in Kansas, and been exposed to the miasma of the Platte valley on the march over the plains. I saw other cases, and the most violent, amongst teamsters from Missouri and Illinois, who had frequently suffered attacks of undoubted malarial fever. The ordinary intermittents and remittents of the Platte valley gradually changed in character as the troops ascended the table lands of the Rocky Mountains, until, having reached the south pass, they merged into that febrile state already described, yet not by an abrupt transition. Those attacks which, it is alleged, have occurred amongst the *habitues* of the mountains, are not well authenticated cases of periodical fever, but were rather typhoid, modified, as I have already shown that affection is, by elevation. In Salt Lake valley, mountain fever is extremely common amongst the *newly-arrived emigrants;* much less so amongst the resident inhabitants, who have undoubtedly typhoid fever, but confounded with the periodical fever, and both known under the same local designation."[1]

While subscribing generally to the views of Dr. Bartholow, above presented, we cannot altogether agree with him, that the periodical form of mountain fever is always found among those who may have recently ascended from the low malarial regions into the more elevated; at least this has not been invariably the case in California. Instances have come within the sphere of our observation of teamsters, who have been engaged, during the spring and summer, in their occupation between the Washoe and the Reese River mining districts, returning to Sacramento for treatment, with all the characteristic features of that modified form of

[1] See Am. Journal of the Medical Sciences, p. 329, April, 1860.

periodical fever so graphically described above. It is true these patients cannot be classed as *habitues* of the mountains, but they certainly sojourned a reasonably sufficient time in the elevated region to preclude the idea of malarial poison having remained latent in their systems. It must be confessed, however, that the type of the fever was somewhat clouded. But is not this attributable to the difference in the density of the air, as revealed by the barometer? We have already shown in our barometric table, as well as in the curve for Sacramento, that the pressure of the atmosphere does not vary in California to an extent sufficient to exercise any appreciable influence upon disease in the valley. May not, however, the diminished pressure alone in the mountain regions, by its physiological effects upon the system, in permitting a free expansion of the fluids, modify the action of the prime cause? The inhabitants of Virginia City, and many of our mountain towns, which are situated from 6000 to 7000 feet above sea-level, must have about one-third atmospheric pressure less than is properly required. Dr. B. Eichler writes, "In most of those diseases which frequently occur here, the effects upon the human organism are more or less as follows: weakening of the joints; less action in the muscular system; increased transpiration and thirst; quickened process of oxydation—which, by the want of oxygen in a rare atmosphere, requires more rapid breathing and deeper inspiration—quicker pulsation and pressure of the blood into the peripheric part; as a consequent, congestion in the capillary vessels, and finally bleeding of those vessels, as a result of too great pressure; also, an increased pressure on the brain, exhibiting itself by headache, vomiting, aversion to food, giddiness, fainting, and inclination to sleep. These effects are most visible in new comers, and grow gradually less as we get accustomed to the influence of this region. A remarkable fact is the quickened act of breathing, caused by want of oxygen in the atmosphere.

"It is stated that a healthy man requires about 30 pounds of atmosphere, and breathes about 20 times in the minute, to receive by normal pressure the necessary oxygen for the organism. According to this statement, we would have to breathe 25 to 30 times in a minute, to receive, by one-third less pressure, the necessary oxygen. This increased action of the lungs requires increased force of all the respirative organs; it must be very oppressive to persons with weak or tubercular lungs, and may be the cause—by weakening and irritating those parts—of bronchitis and pneumonia. I am

also led to believe that weakening of the joints, etc., and defects in muscular action, may be the cause of inflammatory rheumatism. With the quickened action of the lungs, the action of the heart is increased, as the blood, by not finding the necessary deposit of oxygen, is more forcibly pressed with the lungs, and this, too, must be one of the causes of the above-named diseases, by producing congestion and inflammation."[1]

We are inclined to the opinion that too little attention has been given to barometrical phenomena in the production of disease. Its agency in promoting the health of animals and plants, or, on the contrary, in causing them to sicken or perish, is far from being nugatory. Reverting to the subject of the exemption enjoyed by the primitive formations from malarial diseases, it seems to us to be in a great measure due to their greater altitude, affording a freer circulation of air, a lessened humidity, and a lower temperature. Our topographical sketch shows that there are numerous lacustrine localities even among our highest ranges in California, where the sources of humidity exist in abundance. And, even if the theory of decomposition of vegetable growth is worthy of any credit, which we do not accord to it, however, that element also is to be found there. That malaria, therefore, exists in these elevated regions to a sufficient degree for the production of the periodic form of fevers peculiar to alluvial tracts, and which possess the power of impressing their likeness upon almost every disease coming within the range of their influence, is by no means an illogical conclusion. We are not aware, however, of the occurrence of a single instance of that aggravated and malignant form of malarial fever in the mountainous regions which is met with in the great valley. This fact, while it goes to prove the existence of a less intense degree, a diluted condition, perhaps, of the toxical agent in the elevated regions, should settle any doubt, if it exists in the minds of distant theorists, as to the prevailing constitution of the Sacramento and other valleys in the State being malarious. Lest, however, the idea may be imparted, from what we have just stated, that this formidable form of the malarious pyrexiæ is of frequent occurrence in our lowlands, we must here state, that since the fall of 1852, it has been our lot to meet with but very few such cases. At that time Sacramento was visited by what was generally recognized as a second epidemic of cholera, the first, or more

[1] San Francisco Medical Press, July, 1864, p. 72.

strongly marked epidemic having occurred in the fall of 1850, when the young city was almost depopulated by its irresistible ravages.

During this last so-called epidemic of cholera we witnessed many cases presenting phenomena so strongly resembling malignant fever, that the circumstance created much obscurity in our minds as to the pathology of the prevailing disease. In fact we doubted at the time, and still doubt whether the epidemic was really cholera, and so expressed ourselves in several published articles. Be this as it may, however, we certainly then encountered several well-marked cases of that pestilential modification of intermittent fever, with which the practitioners of the southern and western portions of the United States are unhappily too well acquainted. The same lesions of innervation and the same consequences of local hyperæmia, so well described by writers, were manifested in the impeded action of the heart and lungs. The system seemed to sink at once prostrate before the first invasion, which, after a protracted duration, was rarely followed by the well marked typical pyrexia. Since this period the sanitary condition of California has been such that the cases of fever presenting the malignant type have been few and far between, and when these have occurred, it has been chiefly among those whose powers of resistance to disease were feeble. Such have generally proved amenable to therapeutic influence, when a correct diagnosis was formed in the initial stage.

By the mortality curve for Sacramento, projected on the barometric and thermometric diagram, it will be perceived, that in a population varying from 12,000 to 20,000, the proportion of deaths is not greater than that of some of the healthiest cities in the world, notwithstanding the fact that stillborn and premature births are included in our mortality tables. It will be noticed, also, by the sudden dip of the curve in February, that our healthiest season is in the spring and early summer months, while our sickliest or most fatal season appears to be autumn and winter; the curve commencing to rise in July, and attaining its culminating point in November, the first of the rainy season, when the air is more or less saturated with moisture. This is in direct contrast to the rule that obtains in isothermal parallels on the Atlantic coast. Over the whole State the dry or summer season is the healthiest, and the wet or winter season the sickliest.

There is still another form of disease that has prevailed in the neighboring elevated regions during the past year, which remains

to be described in this connection. We allude to the so called "spotted fever," or *epidemic cerebro-spinal meningitis*, now attracting so much attention in the medical world. But five cases have come under our observation at Sacramento, and in these the disease made its advent by impairing first the functions of the brain, subsequently to which the fatal meningeal inflammation supervened. In two out of the five cases the dyscrasic character of the disorder was manifested in the peculiar pathognomonic ecchymoses. The rapid course of these cases to a fatal termination, all coming together unexpectedly and about the same time, prevented that close observation which would enable us to speak with any accuracy or detail, further than to state that the disease responded here in all its phases to that described in the recent medical literature of the subject. The fact that it disappeared as suddenly as it first showed itself, and that it did not spread, would go to show that it cannot be strongly contagious. Nevertheless, we do not doubt that, under circumstances favoring its development, the disease may radiate from the localities in which it first appeared, as it did in Nevada, and thus conform to one of the laws regulating the spread of infectious disorders in general. The following condensed account of this epidemic is, therefore, not without interest. Gold Hill is a new mountain town situated about one and a half mile south of Virginia City, the capital of the State of Nevada, the topography and climatology of which have already been described.

CEREBRO-SPINAL MENINGITIS, OR SPOTTED FEVER.

By Henry F. Hereford, M.D., of Gold Hill, Nevada.

This disease showed itself here early last spring (1864). So far as I could learn, there were about twenty cases. At least three-fourths of these proved fatal. The disease manifested itself without any apparent changes in the weather from what is usual. But the climate is so variable that changes of weather is the rule, and a continuance of any one kind the exception. Hence any atmospherical deviation which may have occurred was not observed. The disease is *always* ushered in with *pain in the back of the head and neck*—often intense and excruciating. Occasionally there are *rigors* with *cold extremities;* and the attending physician will be apt to think he has a case of remittent fever, so well does the disease in question simulate the latter in its incipiency. *Vomiting*, continuous and persistent, occurs early. This is a feature of the dis.

ease, that is apt to lead the physician astray in his diagnosis, and therefore worthy of special note. The *post-mortem* gives a reason for the persistency. The pneumogastric nerve is involved in the congestion that has attacked the brain. The bowels are *obstinately costive*. The pupils of the eye are dilated—or one dilated and the other contracted. One eyelid droops down, and the head being flexed backwards gives the patient a singularly staring expression. This peculiar feature, when once seen, is recognized at a glance the second time. The spots, from which the disease has taken its popular name, commence showing themselves generally during the first twelve hours. They are at first very minute in size and appearance, like a flea bite; and gradually enlarge until they reach the size of a quarter of a dollar. They are of the deep purple color of *purpura hæmorrhagica*, covering all parts of the body. The pulse is feeble and quick, the skin cold and clammy, the urine scanty and highly colored, and the tongue heavily coated with a brownish-white fur. All the symptoms are those of malignant, congestive fever. The *post-mortem* shows no lesion of the stomach, liver, spleen, or other organs, either of the abdomen or thorax. In the posterior portion of the brain and superior part of the spinal cord only do we find evidence of the disease that has made such quick and fatal havoc. Here we find invariably the results of great congestion, and, if the patient has survived twenty-four hours, depositions of lymph and the formation of pus. Within this narrow space the disease has spent its force. Here we find sufficient, in the congestive inflammation, etc., to account for all the symptoms noted—the dilated and contracted pupils, the opisthotonos, the vomiting, etc.

Treatment.—This must be vigorously antiphlogistic. If the patient be seen early, notwithstanding the apparent prostration, general *bloodletting*, cupping, stimulating applications to the extremities, cold to the head, etc., must be resorted to. Early attention should be paid to opening the bowels. For this purpose calomel and podophyllin are preferable. As soon as this is done I put my patient on quinia, nux vomica, and calomel. I hold quinia to be one of the best regulators of the circulation we have. For this purpose I employ it, and have never had cause to regret its use in this disease. There will often be great restlessness and nervousness, which it is advisable to combat with an opiate. These are the main indications of treatment; but so violent is the disease in

its incipiency and yet so insidious, that under every treatment most of the cases prove fatal.

Remarks.—Cerebro-spinal meningitis is very uncertain as to whom it will attack and what locality it will invade. Generally those of bad habits will more surely be its victims; nevertheless, cases have occurred in persons of abstemious habits, in children and young persons in our town and in the adjacent valleys. I have not seen cases enough to warrant an opinion as to what has been or may be its favorite localities, or habits of body most predisposing to its attacks. But, judging from its pathology, I would suppose that hereafter we may look for it in such localities as where we find the usual congestive fever. I consider it a new disease, or, if it be not so, it has been so inaccurately described that we either fail to recognize it, or else, like many other diseases, it has changed in some of its characteristics. War brings many calamities and not unfrequently new and strange diseases.

ADDENDA.—BY THE REPORTER.

Since this report was written, we have, through the courtesy of Surgeon C. S. Wood, U. S. V., and his associate, Dr. A. S. Ferris, been permitted to observe a recent sporadic case of the disease just described, and of which the following notes have been furnished us for publication.

Frank D. Ingraham, aged 25, private, 2d C. C. V., of previous good health, was admitted into Camp Union Hospital, at Sacramento, on the 3d of April, 1865, with the following symptoms, viz: severe pain in the back of the head and neck, preceded by a chill; left eye everted, producing confused vision, except when one eye was closed; pupil inactive, one contracting, while the other was dilated and *vice versa;* numbness and pricking in the arm and hand of left side; pulse 50, and sharp; tongue coated, white; intellect obtuse, without coma; slight opisthotonos, with nervous twitchings; hearing imperfect, except when fully aroused; articulation imperfect.

Diagnosis.—Cerebro-spinal meningitis.

April 3. ℞.—Quiniæ sulph., gr. v.
Spirit. frumenti, f℥j. M.
To be given every three hours.
℞.—Tinct. opii, gtt. xl.
To be given every six hours.
℞.—Emp. epispast. 5 8 ad nucha.
Diet, strong beef-tea *ad libitum.*

4th. No change in symptoms. The same treatment continued.

5th. Pulse a little accelerated—about 55. The same treatment continued.

6th. Patient has less pain in the head; is able to protrude the tongue more perfectly. The same treatment continued.

7th. Patient improving. The same treatment continued, except the dose of tinct. opii to be reduced to gtt. xxx.

8th. Patient still improving. Treatment changed to

℞.—Quiniæ sulph., gr. v.
Spirit. frumenti, f℥j. M.
To be given every four hours.
℞.—Pill hydrarg., gr. v, every night.

10th. This treatment was continued, the patient steadily improving.

16th. The patient is walking about the ward; his eyes are natural; articulation good, and all the organs are performing their functions perfectly, with the exception of the nerves of the left leg and arm, which have not quite yet regained their natural tone.

Remarks.—We insert this case, not because we consider it important in a therapeutic point of view, but for the strong contrast it offers in the treatment with the cases reported by Dr. Hereford, at Gold Hill. At a time like the present, when opium and its alkaloids are so extensively and successfully used in the management of peritonitis with a suppurative tendency, and in inflammations of the thoracic serous membranes, with a view to the prevention of serous effusion, it would be unnecessary to dwell upon the marvellous influence that might rationally be expected, in this respect, from the narcotic treatment. Its efficacy in cerebro-spinal meningitis has been well established by Miner, Hartshorne, Atlee, Lidell, and others. Boudin says that "an *opiate sleep* was often followed by convalescence."

With regard to quinia, however useful it may be in controlling malarial complication, we believe it exerts no influence whatever on the disease. Not so with the stimulus. All the modifications of diseased action we have met with in California are of an asthenic character. Taking this fact in connection with the strongly marked pathological condition of the blood in the disease under consideration, the most striking feature of which is, that its coagulability is almost entirely destroyed, we are decidedly of the opinion that the supporting treatment is absolutely called for.

METEORATIOUS EPIDEMICS.

In the order pursued by us we come now to treat of those diseases which range more or less extensively over the face of the earth, and which, being hence referable to certain insensible and noxious qualities of the general atmosphere, are denominated *meteorations.* But three forms of disease, capable of being thus classed, have, in their migratory movements, been observed to assume the epidemic character in California, viz., influenza, typhoid pneumonia, and diphtheria. Whether it would have been more correct to have considered the latter disorder among the exanthematous epidemics already described is extremely doubtful in our own mind. Its frequent association with scarlatina in epidemics justifies the inference that the *diphtherine*, its *materies morbi*, according to Dr. Farr, is some modification of scarlatinine. Still, we do not know that the relationship between these two special disorders is more intimate than that between the two separate classes themselves in which they are ranked, the diseases in both instances being traceable to the same primary source. Nor are we certain that the evidence for the occasional contagiousness of diphtheria is more conclusive than that adduced for influenza or typhoid pneumonia. While, therefore, with due deference to the opinions expressed by the writer of the monograph on diphtheria, we have determined to place this disorder, as we have done. We desire, at the same time, to be understood as maintaining that the real difference between the strictly contagious and meteorations epidemics consists in the fact that, in the former, "the great majority of cases spring immediately from specific poisons, generated in primary or atmospheric cases, and communicable from one individual to another. Whereas, in meteoratious epidemics, excepting in one or two of them, every case is of atmospheric *origin;* and, in the exceptionable instances, as in the cholera [and to which may be added diphtheria], which is believed to possess the contagious attribute, the great *majority* of cases manifestly arise, not from the diffusion of its contagious virus, but from the existing meteoratious influence." This is in accordance with the views advocated by Dr. Jos. M. Smith, in his elaborate "Report on the Topography and Epidemics of New York," from which we here quote, and whose classification we have adopted.

INFLUENZA.

"In no disease, perhaps," continues the writer just cited, "are the characteristics of a meteorations epidemic better defined than in influenza; or, as the disease is otherwise called, epidemic catarrh. Its sudden appearance and rapid diffusion, its migratory movements, and irregular periodical occurrence; or, in other language, its rise, progress, decline, and cessation, show how widely it differs from ordinary contagious and infectious diseases." With most of these well-known peculiarities the disease prevailed extensively over the whole Pacific coast, from the early part of October, 1863, to the latter part of February, 1864. In its history in California we have nothing of greater import to contribute than the complete confirmation of all that has been so thoroughly compiled in the "Annals" of Dr. Theophilus Thompson, illustrative of the similarity of the symptoms during several centuries, and under every different degree of civilization and hygiene. "We find the affection," to use his words, "in our comparatively luxurious days, manifesting the same phenomena as it exhibited when the presence-chamber of sovereigns was strewed with straw, the entrance of aristocratic mansions obstructed with decaying vegetable matter, and a lantern required at night to guide the weary steps of the citizen through the 'slabby streets' of the metropolis."

The winter, or wet season, which this world wide-spread epidemic elected for its visitation in California, was characterized by the blandest and most genial weather ever experienced in the whole extent of the State, much less rain having fallen than the usual average quantity; in fact, it was a season of comparative drought. For this reason, the wet season being always the sickliest, the catarrhal and peripneumonic symptoms predominated. At the same time, the epidemic was readily recognizable from ordinary catarrh by the great constitutional disturbance, especially of the nervous system, entirely disproportionate to the extent of the local disease, strongly resembling in many of its symptoms the disease known as *dengue*. In many cases, however, there was no cough, no sneezing, and none of the ordinary defluxions from the nasal membrane; so that the disease might have been mistaken for the ordinary fever frequently met with, the pleuritic fever of Sydenham, in which there is a tendency to rheumatic or pleuritic symptoms. In other cases, the pectoral complication was more serious in consequence of the insidious progress of capillary bronchitis. A

sub-crepitant rhonchus, readily detected on the back part of the chest, would, if not heeded, merge, sooner or later, into bronchial difficulty. This was more apt to happen with valetudinarians and the aged, who suffered most severely in every phase of the epidemic. Children, and the robust, proved less liable to its influence, and, when attacked, experienced for the most part the disease in its mildest form; the ephemeral fever passing off on the third day, and sometimes earlier, with a moist skin and profuse perspirations. With respect to the various complications peculiar to the epidemic, our observations square with those of the most eminent writers, in the finding that the pulmonary trouble is not an essential phenomenon, but is attributable "to changes of temperature and other sensible qualities of the atmosphere, as giving rise to the predominance of a certain set of symptoms at one time rather than another. Thus in frosty weather, and during northerly and easterly winds, the catarrhal and peripneumonic affection will be most conspicuous, while in warm weather, and during westerly and southerly winds, the headache, sickness, disordered bowels, glandular swellings, etc., will constitute the most urgent symptoms." This is the testimony of Drs. Pearson and Warren, of Boston, borne out by Sir Henry Holland, and Drs. Graves, Watson, and others. The most constant symptom was the intense mental depression.

Regarding influenza as a condition, not of exalted, but of depressed vitality, dependent upon deranged innervation, according to the views of its pathology, taken by Dr. Graves and Blakiston, and so admirably presented by Dr. Levick,[1] we can thus readily account for the concomitant derangements of the organs of digestion, circulation, etc. "We can comprehend how, when the poison is expended chiefly on the sensorium, we may have buzzings, giddiness, faintness, intense headache, delirium, insomnia. When upon the respiratory centres we have dyspnœa, passive congestions, pulmonary œdema, and the enfeebled lungs left exposed to the assaults of inflammatory or other disease. . . . But in these days of recurrent humoral pathology, it will be questioned how far the disturbance of the nervous system is a primary or a secondary condition; whether the septic influence, acting directly on the blood, may not, in the course of the zymotic changes thus induced, secondarily affect the great nervous centres, which preside over the functions of respiration, circulation, and nutrition."

[1] American Journal of the Med. Sciences, Jan. 1864.

In relation to the question of the fatality of the epidemic influenza in California, we would here state that we are not aware of any deaths having been directly attributed to the ordinary form of the fever (for we regard influenza as essentially a fever as is enteric or typhus fever) uncomplicated with the results of previous or concomitant disease. The tendency noticed especially by the older writers, of the epidemic to act in some instances as a determining cause, in the development of particular diseases incident to particular persons, clothing them in its own peculiar garb, was strikingly manifested. This tendency was to assume, for the most part, a neuralgic or rheumatic affection. To this effect of influenza on other diseases, Dr. Gairdner, of Edinburgh, in his clinical lectures, has especially called attention. He states that "by the influenza of 1847–8 the whole mortality was increased one-seventh. It doubled the deaths from bronchitis; largely increased those of other acute diseases of the chest, while the aged and the very young, the apoplectic, paralytic, and consumptive suffered out of all proportion to the rest of the population. These deaths, though not set down as due directly to influenza, were doubtless due to the epidemic influence of influenza."

In the barometric and thermometric curve, for Sacramento, this effect is sharply defined. The average number of deaths for 14 years during November and December is 37 and 34 respectively—while for the same months in 1863 it was 45 and 49, showing an increase of eight in November and fifteen in December out of a population of about 12,000 persons. The deaths by consumption alone were doubled, while those by pneumonia and all other pulmonary affections computed together were increased about four per cent. over those the preceding ten years averaged.

The precise bearing of the influenza upon the mortality of the year is seen at a glance in the comparison of the two months of its greatest prevalence with those of the previous year. Thus:—

	November.	December.	Total.
1862	34	29	63
1863	45	49	94
Excess	11	20	31

Thus the actual excess of deaths during the two months enumerated over those of the previous year was 31; a difference, which, when we consider that the yearly increase was only 24, explains more emphatically than any argument can do, the powerfully pernicious influence of the epidemics.

We have already stated the condition of the weather at the time of the invasion and during the progress of the epidemic to have been such as not to authorize the inference of any connection, direct or indirect, between meteorological phenomena and influenza. Neither were there any cosmical phenomena, such as comets, meteors, earthquakes, or remarkable disturbances of the electrical or magnetical status noted. Nor did the pressure upon our time permit any such refinements of chemical inquiry as the detection of the amount of ozone in the atmosphere. The attempt to do this by means of Schönbein's papers and scale proved altogether unsatisfactory after a brief trial at our hands. It would seem that an ozonometer, having a scale more definite than the tints now employed, and which will cause the paper to be acted on by a fixed quantity of air during a fixed period of time, is still a desideratum.

We are happy, however, to be able to contribute, in this connection, an item in support of the long entertained opinion, which is quite consistent with modern researches, that some of the most minute beings endowed with life exert a powerful influence on conditions of air and water, calculated to affect the health of the higher classes of animals.

During the summer months antecedent to the year of the influenza, as well as during the summer of its prevalence, one of our colleagues in the Board of Health, already referred to, instituted a series of microscopical examinations into the animal and vegetable forms contained in the standing water in different sections of the city, with the view of contrasting the results on the public health after a season of profuse rains, in fact of inundation, and one of a remarkable draught. In the first instance, the conditions usually considered essential to the production of malaria seemed to be all fulfilled: an alluvial soil, fertile, rich in vegetable decomposition, moisture, and a warm sun. To what degree they were operative the following statements of Dr. H. W. Harkness will testify.

"The inundation of December, 1861, took place at a time when our city was best prepared for it. The vegetation, already completely desiccated by the autumnal sun, had almost entirely disappeared; the deposit of alluvion or sedimentary matter buried the remainder. This sedimentary deposit, so pernicious in many localities, was really to us beneficent. Had the supply of water been derived from the drainage of table-lands, covered with lakes

and swamps, bringing with it the debris of the previous summer's luxuriant growth, together with the myriad germs of plants of a microscopic and larger growth, the results would, no doubt, have been far different. But such was not the case. The water was derived exclusively from the American River, supplied from an exceedingly mountainous and sterile tract of country, furnishing but little of that material which would contaminate the atmosphere, aud, beside the cottonwood and willow, but few of the germs for future growth.

"Owing to the above-named causes and the low temperature of the waters, no deleterious effects were apparent on its subsidence. But there were those who believed that much mischief would result from the great numbers of pools left in every part of the city, and that when these became heated by a semi-tropical sun, fevers would prevail to an alarming extent. These sad forebodings were, happily, not realized.

"To the student of natural history these small bodies of water were a great source of instruction aud delight. In no place on this continent, perhaps, was there ever a better field for the observation of the microscopic world. In none, owing to favorable accidents, was there a greater diversity of the living organisms which the microscope reveals.

"These bodies of water were the favorite localities of the vast family of microscopic plants, whose germs are in many instances conveyed in the air. Amongst these may be mentioned the *Valvox Globator*, the *Bacillaria*, the *Diatomia Vulgare*, and the great family of the *Conjugatæa*—all of which are so minute as to be invisible to the unaided eye. These, if allowed to multiply without hindrance, would soon fill the water, and, although not noxious in their living and growing condition, would on their death and decay poison the air we breathe. Such results are counteracted by a new set of living organisms more wonderful still.

"All our citizens have noticed the green scum found floating on the surface of shallow ponds, from which they are accustomed to turn with disgust, and ascribe to it some injurious property. Push aside with a cane this apparently filthy covering, and you will observe the water, which but a day or two since was turbid, is now sweet and clear.

"Bring a portion of this green scum under the powers of the microscope, and it is found to consist of innumerable slender cylindrical-formed animalcules (the *Enchelia* of Ehrenberg), whose

interiors impart the color from their distension with vegetable matter. And thus has this wonderful change been brought about by the innate wants of this living and growing speck, varying in size from $\frac{1}{12000}$ to $\frac{1}{44000}$ of an inch; the matter which would otherwise decay and putrefy is removed and its noxious effects on man and beast prevented. Other pools are alive with *Monads*, still more minute, whose bodies, from the same cause, impart to the water a tint of paler green. Others, again, are teeming with the *Rotifer Vulgaris* and the *Paramecium*, presenting the appearance of a greasy film as they float upon the surface of the water; the *Vorticella Convullaria*, with its wonderful apparatus for obtaining its food; the *Brachionis*, with its tortoise-like shell; the *Vibriona*, with elongated bodies so small as to require an instrument of great power in order to observe them, and many other varieties—all actively engaged either in the destruction of vegetable matter or in preying upon one another.

"In this manner the equilibrium between the minute vegetable and animal kingdoms is preserved by the action of these living atoms, who have well earned the title of 'Scavengers of Nature.' The water is rendered sweet and clear, and many of the fairest portions of earth are made fit for the habitation of man."

How far the remarkable absence of vegetable forms thus shown, and their subsequent decomposition in and about the standing pools of water may have been capable of affecting the general health, or limiting the amount of malarial poison, can only be conjectured. Although their influence is not demonstrable, nevertheless, it was fully confirmed by the actual sanitary statistics of the year in which these deductions were made, contrasted with those of the subsequent year. In this latter year, the continuous series of examinations, which were made with care and with the same desire for minuteness of accuracy, served to show a vast preponderance of vegetable forms—which, when coupled with the fact of the sickliness of the season, and, ultimately, the appearance of the influenza, is well calculated to sustain the generally received opinion of the source of malarial emanations.

It is a well-recognized fact that generally, and under ordinary circumstances, the mortality of a season bears a certain proportion to the amount of sickness occurring; and, although we cannot indorse the attempt to establish the relation by a fixed and undeviating formula, yet we would here avail ourselves of the benefit to be derived from the mortality reports, which, if they cannot be

made to bear upon this subject the evidence of rigid demonstration, nevertheless may, by a comparison of the season of 1863–4 with the antecedent years, commencing from the time of our last report, enable us to arrive at a well-grounded conclusion. With this view the following table has been prepared, embracing only those diseases usually considered to be more or less intimately associated with a malarial agency.

Table showing the Comparative Mortality by Diseases of Malarious Origin for Five Years to Sept., 1863, and from Sept., 1863, to Sept., 1864.

Diseases.	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		March.		April.		May.		June.		July.		Aug.	
	Five Seasons prior to 1863-64.	Season of 1863-64	Five Seasons prior to 1863-64.	Season of 1863-64.	Five Seasons prior to 1863-64.	Season of 1863-64.	Five Seasons prior to 1863-64.	Season of 1863-64.	Five Seasons prior to 1863-64.	Season of 1863-64.	Five Seasons prior to 1863-64.	Season of 1863-64.	Five Seasons prior to 1863-64.	Season of 1863-64.	Five Seasons prior to 1863-64.	Season of 1863-64.	Five Seasons prior to 1863-64.	Season of 1863-64.	Five Seasons prior to 1863-64.	Season of 1863-64.	Five Seasons prior to 1863-64.	Season of 1863-64.	Five Seasons prior to 1863-64.	Season of 1863-64
Fever, Intermittent	3	2	4	1	2	1	...	2	1	...	...	...	...	...	...	...	...	...	2	...	1	...	1	...
" Remittent	1	...	1	...	3	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
" Congestive, including Spotted Fever	...	2	...	1	...	1	...	2	...	...	2	...	1	2	...	1	...	2	...	...	...	...	...	...
Dysentery	2	...	4	...	3	1	2	1	2	...	1	...	1	...	6	1	3	1	1	...	1	...	2	1
Hepatitis	1	1	1	...	...	...	3	1	2	1	5	...	...	...	3	...	3	1	1	2	...	...	2	...
Total	7	5	10	2	8	3	6	6	5	1	8	0	2	2	9	2	6	4	4	2	2	0	5	1

Of all the diseases enumerated above, it may readily be seen that for the five years from September to August, 1863, inclusive, there occurred 72 deaths in all, or a fraction over 14 annually. Of these, an average of over five are put down to dysentery—a little over four to hepatitis—and nearly five to the various types of malarial fever. While for the one year beginning September, 1863, and ending August, 1864, we find the total number of deaths to be double the average. Seventeen of these deaths are attributable to fevers alone, including, as we have done, five deaths by cerebro-spinal meningitis, or spotted fever; and it is worthy of remark, that diseases of the abdominal cavity which are far from being exclusively, or even most frequently due to like malarial causes, have been scarcely above the average.

That there occurred not only a greater number of deaths by malarious diseases during the eventful year of the influenza, is thus not only conclusively established by the comparative mortality above stated, but it is also consonant with the experience of every medical man, that, throughout the length and breadth of the State, the amount of sickness from every variety of disease was never known to have been greater. Whether any of those numerous forms of enteric and typhoid affections, manifesting all the symptoms of septicæmia, which crowded upon the attention of the practitioner, were attributable to the change of type in the influenza, so often witnessed with other specific fevers, is a question we are not prepared, at this time, to discuss. But if we have no clear statistical information for deciding this point, we at least find evidence in the universal prevalence of sickness just stated, of an epidemic state of constitution, which, originating with the same causes that produced influenza, rendered the body for a period more prone than usual to certain diseases, the material sources of which are ever more or less present. The fact of the appearance of these intercurrent affections, and the subsequent development of cerebro-spinal meningitis, is in perfect keeping with the history of the disease we have just described, whose periodical visitations in all ages have preceded, accompanied, or succeeded epidemics of the most malignant and pestilential character.